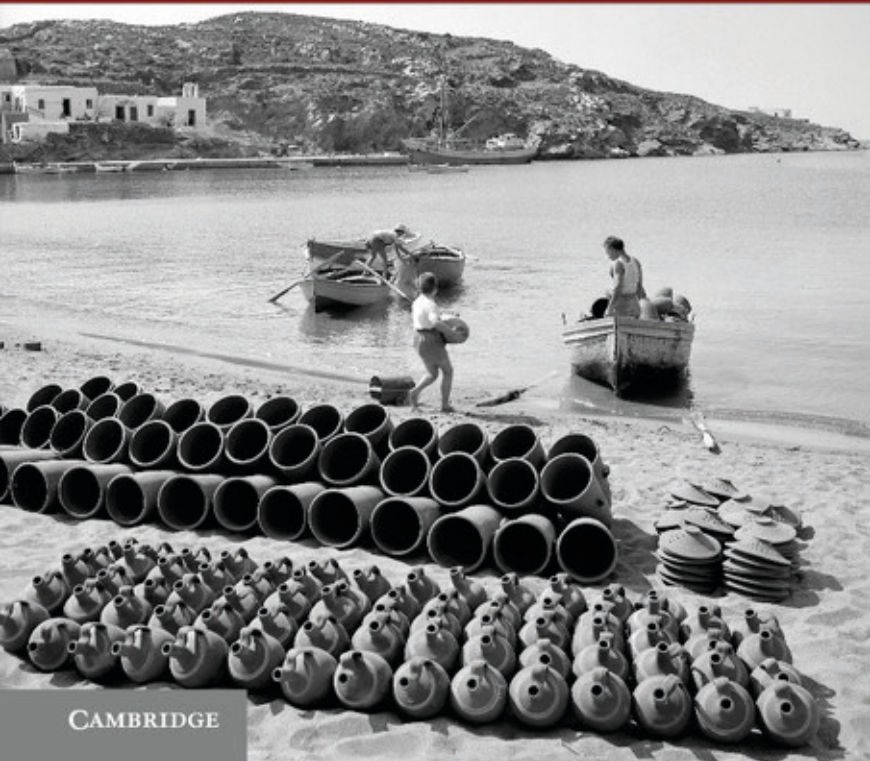


BRITISH
SCHOOL
at
ATHENS

BRITISH
SCHOOL
AT ATHENS
STUDIES
IN GREEK
ANTIQUITY

Human Mobility and Technological Transfer in the Prehistoric Mediterranean

Edited by Evangelia Kiriati
and Carl Knappett



CAMBRIDGE

VISIT...

LANZAROTE
Caliente.COM

Human Mobility and Technological Transfer in the Prehistoric Mediterranean

The diverse forms of regional connectivity in the ancient world have recently become an important focus for those interested in the deep history of globalisation. This volume represents a significant contribution to this new trend as it engages thematically with a wide range of connectivities in the later prehistory of the Mediterranean, from the later Neolithic of northern Greece to the Levantine Iron Age, and with diverse forms of materiality, from pottery and metal to stone and glass. With theoretical overviews from leading thinkers in prehistoric mobilities, and commentaries from top specialists in neighbouring domains, the volume integrates detailed case studies within a comparative framework. The result is a thorough treatment of many of the key issues of regional interaction and technological diversity facing archaeologists working across diverse places and periods. As this book presents key case studies for human and technological mobility across the eastern Mediterranean in later prehistory, it will be of interest primarily to Mediterranean archaeologists, though also to ancient historians, historians and anthropologists.

EVANGELIA KIRIATZI is Director of the Fitch Laboratory for science-based archaeology of the British School at Athens and Honorary Senior Research Associate at the Institute of Archaeology, University College London. She has published *Pottery Production and Supply at Bronze Age Kolonna*, *Aegina: An Integrated Archaeological and Scientific Study of a Ceramic Landscape* (with Walter Gauss, 2011). She carries out studies and fieldwork at numerous prehistoric sites across the Aegean, southern Balkans and Anatolia, and co-directs the Kythera Island Project (with Cyprian Broodbank), investigating the long-term cultural and environmental history of a Mediterranean island.

CARL KNAPPETT teaches in the Department of Art at the University of Toronto, where he holds the Walter Graham/Homer Thompson Chair in Aegean Prehistory. His previous books include *Thinking through Material Culture* (2005), *An Archaeology of Interaction* (2011), and *Network Analysis in Archaeology* (2013). He conducts fieldwork at various Bronze Age sites across the Aegean, and directs the new excavations at the Minoan town of Palaikastro in east Crete.

BRITISH SCHOOL AT ATHENS STUDIES IN GREEK ANTIQUITY

Series editor

John Bennet

Director of the British School at Athens

British School at Athens Studies in Greek Antiquity builds on the School's long-standing engagement with the study of ancient Greece from prehistory to Late Antiquity. This series aims to explore a wide range of topics through a variety of approaches attractive to anyone with interests in the ancient Greek world.

Human Mobility and Technological Transfer in the Prehistoric Mediterranean

Edited by

EVANGELIA KIRIATZI

Fitch Laboratory, British School at Athens

CARL KNAPPETT

Department of Art, University of Toronto



CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning and research at the highest international levels of excellence.

www.cambridge.org

Information on this title: www.cambridge.org/9781107142435

© The British School at Athens 2016

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 2016

Printed in the United Kingdom by Clays, St Ives plc

A catalogue record for this publication is available from the British Library

Library of Congress Cataloguing in Publication data

Names: Kiriatzis, Evangelia, editor of compilation. | Knappett, Carl, editor of compilation.

Title: Human mobility and technological transfer in the prehistoric Mediterranean / edited by Evangelia Kiriatzis (Fitch Laboratory, British School at Athens) and Carl Knappett (University of Toronto).

Description: New York: Cambridge University Press, 2016. |

Series: Studies in Greek antiquity / British School at Athens |

Includes bibliographical references.

Identifiers: LCCN 2016025958 | ISBN 9781107142435 (hardback)

Subjects: LCSH: Prehistoric peoples – Mediterranean Region. |

Mediterranean Region – Antiquities. | Mediterranean Region – Relations. |

Human beings – Mediterranean Region – Migrations – History. | Migration, Internal –

Mediterranean Region – History. | Technology transfer – Mediterranean Region – History. |

Material culture – Mediterranean Region – History. | Regionalism –

Mediterranean Region – History. | Social archaeology – Mediterranean Region. |

BISAC: SOCIAL SCIENCE / Archaeology.

Classification: LCC GN848.H86 2016 | DDC 937–dc23

LC record available at <https://lccn.loc.gov/2016025958>

ISBN 978-1-107-14243-5 Hardback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication, and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

Contents

List of Figures and Maps page [ix]

List of Tables [xii]

List of Contributors [xiii]

Foreword [xv]

Acknowledgements [xvii]

1 Technological Mobilities: Perspectives from the Eastern Mediterranean – An Introduction [1]

CARL KNAPPETT AND EVANGELIA KIRIATZI

The New Mobilities Paradigm [1]

Mobility in Archaeological Theory [2]

Mobility and the Mediterranean [4]

Two Problems with Mobility [5]

Suggestions [7]

Methodology – Technologies [8]

Biological Approaches to Scale [11]

A Situated Learning Approach [12]

Volume Organisation [14]

Concluding Comments [15]

2 The Transmitting Sea: A Mediterranean Perspective [18]

CYPRIAN BROODBANK

Mediterranean Advantages [19]

Technologies of Mobility [23]

The Demographics of Transmission [29]

3 Changing Pottery Technology in the Later Neolithic in Macedonia, North Greece [31]

DUSHKA UREM-KOTSOU

Northern Greece in the Neolithic [33]

Old and New Traditions. MN and LN Pottery Production and Consumption [34]

Mobility of Other Forms of Material Culture [39]

Discussion [41]

Conclusions [45]

- 4 Mobility and Early Bronze Age Southern Aegean Metal Production [46]
MYRTO GEORGAKOPOULOU
Introduction [46]
Metal Production and Metalworking [47]
EBA Southern Aegean Metal Production: An Inherently
Mobile *Chaîne Opératoire* [49]
Technological Traditions in EBA Southern Aegean Smelting [60]
Discussion [64]
- 5 Stonemasons and Craft Mobility in the Bronze Age Eastern Mediterranean [68]
ANDREW BEVAN AND ELIZABETH BLOXAM
Introduction [68]
Contexts for Learning [70]
Egyptian Stone-Working: 3rd–2nd Millennium BC [74]
Late Bronze Age Aegean Stone-Working [85]
Conclusions [92]
- 6 Towards an Understanding of the Origin of Late Bronze Age Greek Glass [94]
ANDREW J. SHORTLAND
Introduction [94]
Objects and Technology [95]
Provenance [96]
Evidence for Exchange of Glass [98]
Greek Glass [98]
Isotopes and Reinterpretation [100]
- 7 Mobilities in the Neopalatial Southern Aegean: The Case of Minoanisation [102]
IRENE NIKOLAKOPOULOU AND CARL KNAPPETT
Introduction [102]
Existing Approaches [103]
A Multi-Scale ‘Learning’ Model [105]
Mobility of Minoanising Technologies [105]
Discussion: Technological Mobility through Space and Time [111]
Conclusions [114]
- 8 The Archaeological Signatures of Mobility: A Technological Look At ‘Aegeanising’ Pottery from the Northern Levant at the End of the 2nd Millennium BC [116]
MARIE-CLAUDE BOILEAU

- Introduction [116]
 - The ‘Aegeanisation’ Process of the Levant [117]
 - The Archaeological Signature of Immigrant Artisans [119]
 - Micro-Scale Approach: Aegean and Aegean-Style Wares from
Tell Kazel (Syria) [121]
 - Conclusion: Bridging Local Histories to Wider
Regional Perspectives [127]
- 9 Mycenaean and Mycenaeanising Pottery across the
Mediterranean: A Multi-Scalar Approach to Technological
Mobility, Transmission and Appropriation [128]
EVANGELIA KIRIATZI AND STELIOS ANDREOU
- Introduction [128]
 - Setting the Agenda [130]
 - The Top-Down Perspective [132]
 - The Bottom-Up Perspective [136]
 - Central Macedonia [137]
 - Central Mediterranean [146]
 - East Aegean and East Mediterranean [149]
 - Concluding Remarks [151]
- 10 Interpreting Bronze Age Trade and Migration [154]
KRISTIAN KRISTIANSEN
- Introduction [154]
 - Theorising Mobility: Cognitive Geographies and Networks [155]
 - The Rise of New Mobility Technologies and Institutions [157]
 - The Formation of New Maritime Institutions in
Scandinavia and Beyond [161]
 - Land-Based Networks: Traders and Travelling Warriors
during the 15th and 14th Centuries BC in Europe, and Links with
the Mediterranean World [165]
 - The 12th-Century BC Exodus from the Po Valley and the
Sea Peoples [172]
 - Conclusion: From Bronze Age World System to Bronze Age Value
System [179]
- 11 Commentary: States and Technological Mobility – A View from
the West [181]
EMMA BLAKE
- Introduction [181]
 - The Italian Example [182]
 - Mobility and the State [184]
 - Modelling the Movement of Specialists [189]
 - Conclusions [192]

12 Commentary: On Fluxes, Connections and their Archaeological
Manifestations [193]

OLIVIER P. GOSSELAIN

Connectivity [193]

Mobility [195]

Community [199]

Utility [202]

Bibliography [206]

Index [272]

Figures and Maps

- 3.1 Map of the Aegean showing location names mentioned in the text (drawn by Nikos Valasiadis) *page* [32]
- 4.1 Simplified diagram showing basic steps involved in the production of metals and associated archaeological remains (designed by the author) [47]
- 4.2 Map of the Cyclades and southeast Attica showing location of smelting sites discussed in the text (drawn by Nikos Valasiadis) [52]
- 4.3 View of Kythnos from the Kephala (Seriphos) slag heap (distance c.14 km) (author's photo) [54]
- 4.4 View of Akrotiraki (A), Skali (B), and Kasela (C) from opposite coast of Platy Gialos bay (Siphnos) (author's photo) [56]
- 5.1 Map of Egypt showing the sites mentioned in the text (drawn by author) [74]
- 5.2 Aswan West Bank silicified sandstone quarries: (a) a typical oval grinding stone, and (b) truncated New Kingdom obelisk(?) still partially attached to bedrock (author's photo) [77]
- 5.3 Quarry roads: (a) at Aswan, and (b) at Widan el-Faras (author's photo) [79]
- 5.4 Non-local stone tools from northern Faiyum quarries: (a) in diorite (found at Umm es-Sawan), (b) Cephren gneiss (Umm es-Sawan), (c) granodiorite (Umm es-Sawan), and (d) gabbro (Widan el-Faras) (author's photos) [82]
- 5.5 (a) Roth's (1991, fig. 7.4 with additions) tentative reconstruction of the spatial organisation of work by phyle groups at the Sun Temple, based on records preserved on four limestone tablets from the site; (b) a small cup, seemingly of Chephren gneiss, found on the Aegean island of Kythera but with an inscription identifying it as from Userkaf's Sun Temple, and (c) a small vessel pre-form from the Chephren gneiss quarries at Gebel el-Asr (author's photos) [84]
- 5.6 Map of the southern Aegean showing the sites mentioned in the text (drawn by author) [86]

- 5.7 (a) 'Gate/window' marks on ashlar blocks from Knossos, and (b) a similar mark at a quarry near Palaikastro [88]
- 5.8 Corbel vaults: (a) at Tiryns and (b) Hattusa [92]
- 9.1 Map of the Mediterranean with locations mentioned in the text (drawn by Nikos Valasiadis) [129]
- 9.2 Map of central Macedonia with locations and sites mentioned in the text (drawn by Nikos Valasiadis) [138]
- 9.3 Common types of local handmade pottery in central Macedonia (courtesy of Thessaloniki Toumba excavations; designed by Nikos Valasiadis) [139]
- 9.4 Mycenaean pots of LH IIIA–B from Thessaloniki Toumba (courtesy of Thessaloniki Toumba excavations; designed by Nikos Valasiadis) [140]
- 9.5 Mycenaean pots of LH IIIC from Thessaloniki Toumba (closed shapes) (courtesy of Thessaloniki Toumba excavations; designed by Nikos Valasiadis) [142]
- 9.6 Mycenaean pots of LH IIIC from Thessaloniki Toumba (open shapes) (courtesy of Thessaloniki Toumba excavations; designed by Nikos Valasiadis) [143]
- 10.1 Model of mobile Bronze Age specialists and their institutions (created by Kristian Kristiansen) [159]
- 10.2 The distribution of V- and U-notched shields is evidence of a globalised Bronze Age maritime world, and rock art as an accompanying maritime ritual [163]
- 10.3 Distribution of foreign swords connecting south Germany and Denmark, versus the distribution of Nordic full-hilted swords (1969) [168]
- 10.4 During the 15th and 14th centuries BC a maritime Mediterranean trade network was linked to a land-based trade network that connected south Scandinavia with south-central Europe and the Mediterranean (Kristian Kristiansen. Artwork: Richard Potter) [171]
- 10.5 Graph showing the rapid rise and later decline of population in the Terramare culture, compared with a more normal curve [174]
- 10.6 Swan-headed ships, real and symbolic from Egypt (a1) to Greece (a2), and central Europe (b). Hybrid warriors from the Medinet Habu stelae (c) in Egypt [176]

- 10.7 The distribution of violin bow fibula from 13th century onwards showing the movement of people between northern Italy, Illyria and the Aegean, Crete and the parallel distribution of 'foreign' dark-surfaced handmade pottery (Artwork: Richard Potter) [[179](#)]

Tables

- 4.1 Main smelting sites discussed in the text *page* [\[57\]](#)
- 4.2 Sites with perforated furnace fragments in the southern Aegean [\[62\]](#)

Contributors

STELIOS ANDREOU

Department of History and Archaeology, Aristotle University of
Thessaloniki

ANDREW BEVAN

Institute of Archaeology, University College London

EMMA BLAKE

School of Anthropology, University of Arizona

ELIZABETH BLOXAM

Cardiff University/Institute of Archaeology, University College London

MARIE-CLAUDE BOILEAU

Penn Museum, University of Pennsylvania Museum of Archaeology and
Anthropology

CYPRIAN BROODBANK

McDonald Institute for Archaeological Research, University of
Cambridge

MYRTO GEORGAKOPOULOU

Fitch Laboratory, British School at Athens/UCL Qatar

OLIVIER P. GOSSELAIN

Centre de Recherches et en Archéologie et Patrimoine, Université Libre de
Bruxelles

EVANGELIA KIRIATZI

Fitch Laboratory, British School at Athens

CARL KNAPPETT

Department of Art, University of Toronto

KRISTIAN KRISTIANSEN

Department of Historical Studies, University of Gothenburg

IRENE NIKOLAKOPOULOU

Ephorate of Antiquities for the Dodecanese, Ministry of Culture, Education
and Religious Affairs

ANDREW J. SHORTLAND

Cranfield Forensic Institute, Cranfield University

DUSKA UREM-KOTSOU

Department of History and Ethnology, Demokritus University of Thrace

Foreword

The establishment of a new monograph series – British School at Athens Studies in Greek Antiquity with Cambridge University Press – marks a fresh direction for the British School at Athens. The School has a distinguished and continuing tradition of publishing the results of its archaeological fieldwork in its *BSA Supplements*. Yet its advanced research extends much more broadly to cover Greek antiquity in its fullest sense and in fields from epigraphy to science-based archaeology. Underlying the creation of this new series is our desire to bring the full range of our work to the widest public.

It is a particular pleasure to present as the first volume an edited collection which reflects a key aspect of the research of the School's Fitch Laboratory for Science-based Archaeology since its foundation in 1974. For over forty years, Laboratory staff have developed perspectives on technological practice and technological landscapes, moving from micro- to macro-scales, from individuals and their place in communities to trade networks of varying scale and extent. Mobility and the transmission of technological knowledge and practice are among the long-standing interests of the present Laboratory Director, Evangelia Kiriati, whose inspiration this volume is. In collaboration with Laboratory colleagues, visiting researchers, and a wide range of School field projects, she and her co-editor, Carl Knappett, have been instrumental in developing research agendas that embed science-based archaeology seamlessly within larger perspectives. The present volume includes the work of many such collaborators, as well as past and present Laboratory staff.

As the editors emphasise, the current 'mobility turn' holds great potential as we seek to build on insights into the Mediterranean as a sea of opportunity, where mobility was an essential fact of survival and prosperity, and where a multi-scalar approach is essential to understanding links of time and place. The various contributors to this volume place materials, technologies, practices and their transmission at the heart of the discussion. The results, as Olivier Gosselain observes, already offer important insights into notions of connectivity, mobility, community and utility. They will surely prove to be of even wider significance, for example, in exploring aspects

of materiality where understanding the polysemy of artefacts is an important step in assessing their agency and relationship to the non-material. The workshop, which the British School was pleased to host in 2010 when I was School Director, served as a milestone in Fitch research. The book now developed from it furthers conversations opened on that occasion in ways which will surely be of lasting influence.

Catherine Morgan
All Souls College, Oxford
Director, The British School at
Athens (2008–2015)

Acknowledgements

This volume emerges from a two-day workshop we organised at the British School at Athens in June 2010. We invited fifteen researchers with interests in the technologies of the prehistoric Mediterranean to present their work, with commentary from Olivier Gosselain, a specialist in the anthropology of technology, particularly focused on contemporary technological traditions in sub-Saharan Africa. A further twenty academics and postgraduate students with a special interest in the theme attended the workshop and participated in the discussion. The workshop was successful enough to convince all the contributors that a volume would be very worthwhile, and indeed nearly all of those presenting papers during the workshop contributed chapters. Both the workshop and the publication have been supported through a generous grant by The Richard Bradford McConnell Trust. We would like to express our immense gratitude and appreciation to The Managing Committee of the Trust, and mainly Mrs Patricia Whittock, for making this event and the current volume possible.

The British School at Athens has supported our efforts throughout, from the hosting of the workshop, through the long editing process, and into the final stages when the manuscript was selected to be the first publication in its new series with Cambridge University Press, 'Studies in Greek Antiquity'. We are especially grateful to the then Director of the School, Professor Cathy Morgan, and to its Chairman, Professor Malcolm Schofield, for all their help. Our two anonymous reviewers gave selflessly of their time and truly helped to improve all the contributions. Nikos Valasiadis provided expert support in the preparation of the illustrations and, in collaboration with Rena Veropoulidou, prepared the index at very short notice, while Georgia Kordatzaki checked and edited all references and compiled the final bibliography – we are most grateful to all of them. Lastly, we warmly thank all the contributors for their patience in staying with us through the delays between the workshop and publication!

Evangelia Kiriati
and
Carl Knappett

1 | Technological Mobilities: Perspectives from the Eastern Mediterranean – An Introduction

CARL KNAPPETT AND EVANGELIA KIRIATZI

Abstract

In this introduction to the volume we argue that the later prehistory of the Mediterranean has much to contribute to current debates in the humanities on the subject of mobilities. Although often avoided or maligned for its association with migration as an outmoded explanation for culture change, mobility is belatedly finding its way back into archaeological interpretation. We propose that the papers assembled here effectively bring out the range of mobilities in later Mediterranean prehistory, with a particular focus on the circulation of technological knowledge at different scales.

The New Mobilities Paradigm

With this book we aim to foreground mobility as a fundamental condition of ancient societies. Archaeology identifies instances of mobility in the past as a matter of course; and yet there is a lack of explicit thinking about the range of forms of mobility, and their effects upon society. While our outlook is distinctively archaeological, as we will show, important lessons can be learnt from neighbouring disciplines. Indeed, there is a fresh focus on mobility in the social sciences; it has even been called a new paradigm (Sheller and Urry 2006), or a ‘mobility turn’ (Cresswell 2011). Clifford (1997) is often cited as the key voice inciting this move, with his call for a focus on ‘routes’ and not just ‘roots’, that is to say, acknowledging movement and mobility as inherent, and not just an adjunct: “cultural centres, discrete regions and territories, do not exist prior to contacts, but are sustained through them, appropriating and disciplining the restless movements of people and things” (Clifford 1997, 3). This call has been instrumental in generating an open analysis of globalisation, a necessary reaction to a ‘sedentarist’ perspective that has supposedly afflicted disciplines like geography, sociology and anthropology. With significant input from human geography (and see the new journal *Mobilities*, for example), the focus is very much on contemporary life, and is innovative as a framework in a number of ways.

First, mobilities research seeks to link different scales, “from small-scale bodily movements ... to global flows of finance or labour” (Cresswell 2011, 552). Second, it also focuses on the movements of a variety of things along with humans, including objects. Third, mobility is “considered in relation to forms of place, stopping, stillness and relative immobility” (Cresswell 2011, 552). And fourth, it takes seriously the differential politics of mobility. Indeed, mobility is relational: it is “an orientation to oneself, to others, and to the world” (Adey 2010, p. xvii).

Even if Cresswell did not have the past in mind when identifying these points of interest in the mobility turn, each of them is highly salient for archaeological purposes. Indeed, the assumption that global mobility today contrasts with some kind of static past is picked up on by Flood, who argues that remarkable mobility also occurred in premodern periods – not least in the history of Islam, in which migration and pilgrimage are foundational (Flood 2009). Archaeology has, arguably, not been all that ‘sedentarist’, but neither has an explicit concern with mobility been well expressed. So, these new directions for research in human geography can be extremely useful as a focus for a more coherent approach in archaeology too (see Sorge and Roddick 2012; Beaudry and Parno 2013). In order to put into context a renewed interest in mobility, we now briefly review how mobility is treated in archaeological theory.

Mobility in Archaeological Theory

Mobility has slipped in and out of the stream depending on the dominant academic paradigms. Human mobility, usually on the scale of populations, was central to the culture-historical approach that dominated most European archaeological research in the early to mid-20th century (and occasionally still persists). In this context, migration, invasion, trade, colonisation or diffusion were popularly invoked to interpret similarities and differences in the material cultures of sites or regions (Childe 1929; Trigger 1989). Mainly under the influence of positivism, the so-called ‘processual’ archaeology, later in the 20th century, shifted the emphasis towards explaining cultural change and its reflection in material culture in terms of endogenous processes: exogenous factors previously associated with mobility were seen as simplistic and naïve, and concepts associated with these terms such as migration and colonisation outdated and anachronistic (Binford and Binford 1968; Clarke 1973; Trigger 1989). Yet, the growing application of scientific techniques to the investigation of archaeological

materials also gave new impetus to the study of trade and circulation of material goods, even though such work was rarely properly integrated into archaeological research (movement of goods was thus identified but not always studied in its socio-economic and cultural context). More recently, under the influence of post-processual approaches, new perspectives on the study of mobility have emerged, integrating more systematically evidence generated using a growing number of scientific techniques (Colledge and Conolly 2007; Zakrzewski 2011; Colledge et al. 2013).

Mobility is thus attracting greater attention in current archaeological discourse, with parallel developments in the relevant theoretical and methodological approaches. A shift has taken place away from paradigms constructed under the influence of the empirical tradition and theoretical models such as world systems analysis, and towards post-colonial approaches (Dietler 2010; van Dommelen and Knapp 2010; note the impact here of some of the globalisation literature; see also LaBianca and Scham 2006; Jennings 2011; Versluys 2014) and network thinking (e.g. Knappett 2011a). Beyond the development of more appropriate interpretative models, a burgeoning range of methods and techniques developed in disparate fields, from genetics, chemistry and geology to Information and Communication Technology, can be now applied to the study of ancient material culture. Thus the archaeological study of mobility becomes very timely.

Arguably, we can see a more explicit concern for mobility now emerging in macro-scale work too, for example, in the volume *Deep History*, which has a chapter on ‘migration’ as viewed over the very long term (Shryock and Lord Smail 2011). Spatial displacements are key events in humans’ deep history. For example, the Palaeolithic movement of modern humans out of Africa (e.g. Klein 2008) and across the globe is a major research topic (with the peopling of the Americas c.15,000 years ago much debated – Stanford and Bradley 2012); the Neolithic spread of farming across Europe (e.g. Robb 2013) is another critical instance of complex spatial displacements and mobility. However, they are largely conceived at the *population* level, with little scope for shifting down the scale to evaluate the perceptions and values of those individuals and communities on the move (see Robb 2013, on this scale issue) which is precisely the kind of scale-shifting that ‘mobility’ as a contemporary concept is able to address. In early historical periods, we have documented population movements, with Greek and Phoenician colonisation across the Mediterranean, with the capacity to name the colonies, their foundation dates and their originating cities (Boardman 1980; Malkin 2011). Furthermore, we see evidence for mobilities at a much more individual scale as well, and with a range of motivations; this applies to

the Near Eastern world as well as the Classical, where written sources, not least the *Odyssey* and *Iliad*, provide a level of narrative detail missing from some earlier periods. But although in Classical archaeology the evidence may afford the bridging of scales, this subdiscipline sees only sporadic integration within broader archaeological theory.

Mobility and the Mediterranean

The examples of Greek and Phoenician colonisation here raise the issue of the specifically Mediterranean nature of our enquiry: the ‘inside out’ topography of this region, with landmasses facing onto a single body of eminently navigable water, itself dotted with islands, would seem to scream out for ‘spatial displacement’. The Mediterranean thus attracts narratives of mobility in late prehistory, protohistory and history like no other (e.g. [Horden and Purcell 2000](#); [Abulafia 2011](#); [Broodbank 2013, Chapter 2](#), this volume). However, there has been disagreement as to whether mobility is a unifying or fragmenting force. Although Braudel was the first to study the history of the Mediterranean and the Mediterranean world as a whole, he argued that there is no single Mediterranean Sea but there are many seas ([Braudel 1972](#)). Contemporary scholars have identified fragmentation as a fundamental feature of landscape, culture and history in the Mediterranean, arguing that Mediterranean unity is an intellectual construct (e.g. [Theroux 1995](#); [Carpentier and Lebrun 1998](#); [Norwich 2006](#); [Abulafia 2011](#)). Horden and Purcell (2000) also talk about exceptional fragmentation and see the Mediterranean as numerous micro-landscapes and seascapes with extremely unstable and unpredictable prevailing environmental conditions. However, for them it is mobility and connectivity that link the micro-regions and compensate for the uncertainty, making the Mediterranean a place of opportunity as well as risk, when people choose to pool resources, relocate in bad times or seek gain abroad in good. As Broodbank (2013) underlines, whatever its scale and however it is characterised (in diverse terms from exploration to diaspora, subsistence, kinship or mercantilism), mobility is a shared necessity “for survival and prosperity in a Mediterranean theatre full of challenges and opportunities”.

So, the role of mobility (of any type and in any scale) and connectivity in shaping Mediterranean world(s) through time has been central, as the Mediterranean has been a “global microcosm” ([Alcock 2005](#)), the meeting (and melting) point for some of the most important civilisations (Assyrian, Egyptian, Minoan, Mycenaean, Phoenician, Greek, Roman) and some of

the most influential religions. This volume covers the later prehistory of the Mediterranean, when the landscape, environment and climate had acquired, more or less, their familiar form (Broodbank 2013). It is mainly during this period, and especially towards the late 2nd millennium BC, that distant places within the Mediterranean become more connected; people travelled from one end to the other, and there were people living in one end that knew about those in the other, the earliest period of wide and continuous mobility. And yet, mobility is far from the norm throughout the millennia of the Mediterranean's late prehistoric occupation; or rather, there are many different kinds of mobility, with almost innumerable motivations at the individual and community level. On the whole, although new lifestyles emerge in many parts of the Mediterranean, patterns of occupation set in the Neolithic appear to continue in other parts. So we are faced with the challenge of how to characterise the mobilities we encounter or imagine. There are two immediate problems.

Two Problems with Mobility

The first problem arises when mobility is defined only at a single scale, instead of at multiple scales. For example, mobility can all too easily come to be equated with macro-scale processes such as migration. However, such movements are relatively intermittent and infrequent; are we then to assume that immobility and sedentarism then take over once migration is 'complete'? There are many other kinds of mobility, at different scales. Perhaps we can better imagine mobility being an everyday condition of existence for hunter-gatherer communities, rather than an extraordinary event.¹ With the association of farming communities with sedentism, perhaps it seems more natural to assume 'immobility' as the norm. Nonetheless, there is plenty of evidence to indicate that a degree of mobility was a condition of life in sedentary communities too, and often a prerequisite for physical and social reproduction, through marriage networks, trade, hunting, etc.

One way in which mobility has recently been reimagined for Bronze Age European communities involves striking individual mobility on the part of a select, influential few. According to a recent synthetic treatment, we should have in mind Odysseus as a model (Kristiansen and Larsson 2005; Chapter 10, this volume), not to retroject Classical ideas, but simply to get

¹ See also 2006 special issue of *Journal of Anthropological Archaeology* on Mesolithic mobility; and Barnard and Wendrich (2008).

used to thinking that extreme mobility could well have been the norm for some individuals. Indeed, the mobility of particular individuals may have become institutionalised in the course of the Bronze Age, at least in northern Europe, with war leaders having a distinct source of power from ritual leaders, the former based largely on long-distance mobility and trade (Earle and Kristiansen 2010a). This is an important shift of perspective, one that disentangles mobility from migration. It has the strength of identifying motives for mobility at the micro-scale, while also maintaining a 'global' perspective in terms of the impact of such mobility. For example, one might distinguish two kinds of objective for mobility in the political economies of early complex societies: staple finance and wealth finance respectively (Earle et al. 2011). However, while this kind of distinction may be salient for some aspects of the elite-driven international commerce of the Mycenaean period (Burns 2010), it is too crude for many other situations (cf. Nakassis 2010). Taking this kind of perspective, focused on elite political economies, and assuming that mobility was the preserve of a select few, disallows the possibility of very varied kinds of mobility, spread more widely across society. We can be lulled into thinking that an interconnected world was achieved by mobility solely in the domain of the chiefly elites, set against a background of immobility at the household level. This may not allow us to do justice to mobility across a wide range of circumstances, such as in the Early Bronze Age (EBA) Cyclades (Broodbank 2000), or in processes of 'Minoanisation' (Broodbank 2004; Chapter 7, this volume) or Mycenaeanisation (Chapter 9, this volume). These may well have involved a much wider section of the population, in many different kinds of, and motivations for, spatial displacement.

The second problem, when it comes to mobility, concerns how we conceptualise the relationship between humans and their artefacts. In old-fashioned culture history, ironically, they were very much inseparable, with the equation of 'pots equals people'. The counter-reaction to this essentialist viewpoint saw them pulled apart. And yet they are deeply interconnected: to talk of the movement of human populations must also be to speak, in most instances, of the movement of artefacts and technologies. However, there are many different kinds of mobilities for these phenomena, and they do not always map neatly onto one another: the movement of artefacts reflects some level of human movement, but is it the movement of an individual, a community or an entire population? This is a particular challenge we face for the Bronze Age, where we do see the mobility of raw materials, finished products and technologies, arguably at an unprecedented scale. Yet it is hard to know what these artefactual and technological displacements represent in terms of human movements, with so many possible causes and

circumstances of mobility; some of these will inevitably remain beyond our reach in prehistory.

Suggestions

So what can we do to respond to these problems? First, we ought to think much more clearly and explicitly about the potential diversity in who was moving and why. This may then allow us to grasp a fuller range of causes for cultural convergence, without reverting to outmoded interpretations of culture diffusion. Secondly, we need to make proper use of the abundant and diverse material culture forms available for study, a particular strength in the archaeology of the Bronze Age east Mediterranean. For example, Kristiansen argues that material culture may have been actively engaged in facilitating mobility between regions, with standardised forms – particularly those closely associated with the body, and personal identity – serving as a ‘passport’ to mobility, opening doors and establishing familiarity (Chapter 10, this volume). But on the other hand, one can imagine situations in which mobility may actually have been hindered by material culture markers. Thirdly, distinctive to our approach is the idea that mobile humans may be accompanied by technologies, in the general sense, as ways of doing things, from cooking to potting, from cultivating a field to sailing a boat or fighting a battle; and that technologies can be transmitted through different kinds of human interaction and mobility.

One of us (CK) has come across probable signs of human mobility in researching the spread of technological practices from Crete to the Cyclades, but has faced problems in interpreting this spread satisfactorily (e.g. Knappett and Nikolakopoulou 2008; Chapter 7, this volume). The other (EK) has developed ideas of mobility in her research on technological practice, coming across evidence for relocation of potters that is suggestive of marriage networks in Final Neolithic (FN) southern Greece (Kiriati in press), migrant potters from Crete to Kythera in Early Bronze Age (Kiriati 2003; Broodbank and Kiriati 2007) as well as mobile potters travelling from Middle Bronze Age Kythera to the Greek mainland (Kiriati 2010), from the Mycenaean core areas to central Macedonia (Kiriati 1999; 2000), and elsewhere in the Mediterranean (Chapter 9, this volume). Hence this volume: to serve as a forum for discussing research agendas and methodologies combining technological practice and landscape knowledge at the micro-level, such that they might then be integrated into macro-level narratives and processes. Combining the

two is not an easy feat, and both of us as volume editors feel that there are one or two difficulties to overcome moving forward.

Methodology – Technologies

Methodological limitations are in part to blame, particularly the difficulties in the archaeological identification of human mobility; there are no neat equations between material culture and social identity. What we need is a set of approaches that can reveal the complexities of material practices as they relate to human mobility, which means going beyond simply looking at material culture as a proxy for human mobility. This volume therefore seeks to develop *technological* perspectives on the processes of human movement, focusing primarily on the diverse landscapes and seascapes of the prehistoric Mediterranean.

Technology is increasingly viewed as a social phenomenon in archaeology, thanks to the recognition of the importance of agency in social practice. Technology as skilled and situated practice is thus very much interwoven with social identity. Based on the fact that people usually move not only with their beliefs and worldviews, but also their artefacts (personal belongings or objects of trade/exchange) and technological knowledge, the study of the transfer of technology within or across landscapes can contribute significantly to the understanding of wider mobility phenomena, especially in the context of Mediterranean prehistory.

What is *technological mobility*? First, it could describe a technology that in and of itself requires mobility to integrate its various components. For example, in early metallurgy, artisans needed to travel across physical (and perhaps social) landscapes in order to find exploitable ores (see [Chapter 4](#), this volume). Second, it might concern a technology that a group readily carries to a new location. Various kinds of subsistence and craft technologies are adapted to particular social and material landscapes, though some seem more readily transferred than others. Why is this? What features make for these kinds of mobile technologies? Third, a mobile technology could be one that is readily transferred between two groups separated in physical and social space. Again, some technologies seem to lend themselves to such transfer and transmission more than others. Why? We can think about this in 20th-century contexts, such that some Western technologies have ‘colonised’ the developing world much more deeply than others ([Edgerton 2006](#)). This means we have to rethink technological change; it is not always a process of pure invention and innovation, but is also often a matter of technological transfer, transmission and translation.

With its extensive geographical and temporal scope, archaeology has rich potential as a domain for exploring the intersection of human mobility, technology and landscape. New combined biomolecular approaches are helping identify ancient population movements (e.g. Bentley 2006; Irish 2006; Montgomery and Evans 2006; Coppa et al. 2007; Zakrzewski 2011; Shapiro and Hofreiter 2012; Giblin et al. 2013),² and (archaeo)material science has a long history now of identifying long-term patterns in the movement of artefacts (Knapp and Cherry 1994; Whitbread 1995; Stos-Gale 2000; Carter and Kilikoglou 2007; Haskell et al. 2011; Yavuz et al. 2011). Technological mobility, however, has received much less attention. This volume sets out to fill this gap, systematically exploring questions concerning technological mobility. Some of the key issues include:

- What makes some technologies more mobile than others?
- Is it social context that recasts technologies? Or does the technology itself also enact the way it is taken up?
- Do certain technologies move preferentially into particular landscapes?
- What does it take for a technology to be recognised as mobile?
- How is technological knowledge invented, borrowed, appropriated, transmitted, adopted and reproduced?
- Can technologies manifest different mobilities across spatial scales, e.g. intra-settlement, inter-settlement and inter-regional?
- Are some technologies more mobile through time than others? How does a technical tradition propagate? Why does a technology change over time and space?
- Is a 'convergence' of cultures in the Bronze Age achieved solely through the mobility of traders/merchants, and the flow of commodities, in particular metals? Or is there greater social mobility than we have anticipated, with more kinds of people moving and for more kinds of reasons?

We are not alone in seeing gaps that need filling. A number of projects have blossomed in Europe in the last few years, with the express goal of understanding ancient mobilities: *Forging Identities: The Mobility of Culture in Bronze Age Europe* (www.forging-identities.com/); *Material Connections: Mobility, Materiality and Mediterranean Identities* (AHRC, van Dommelen and Knapp 2010); *Tracing Networks: Craft Traditions in the Ancient Mediterranean and Beyond* (Leicester, Leverhulme, www.tracingnetworks.ac.uk/content/web/introduction.jsp); *Mobilität und Wissenstransfer in diachroner und interdisziplinärer Perspektive* (www.topoi.org/event/mobilitaet-und-wissenstransfer-in-diachroner-und-interdisziplinaerer-perspektive/),

² We thank Sevi Triantaphyllou for help with providing references here.

a workshop in the DFG project *Topoi: The Formation and Transformation of Space and Knowledge in Ancient Civilizations*).

So, how is the Fitch Laboratory tapping into this *Zeitgeist*? Or is it doing something different? The Fitch Laboratory's angle is distinctively science-based and technological, and has been developing its perspective for the past thirty years. In the beginning, the scale of analysis was macro and inter-regional, with typical early problems tackled being the provenance of Greek transport amphoras (Whitbread 1995), the production and circulation of Mycenaean pottery in south Italy (Vagnetti and Jones 1988) or the trade of stirrup jars between Crete and mainland Greece (Jones 1986, 477–93). But over time the scale of analysis changed from macro to micro. It emerged that broad regional patterns could not really be grasped without a firm grip on the local – both in terms of the material resources and technological practices. The shift in scale thus has gone hand in hand, though perhaps not always explicitly, with a shift to technology, and particularly the use of the *chaîne opératoire*, situated within certain landscapes, the study of *technological landscapes* (Kiriati 2003; Gauss and Kiriati 2011; Kiriati et al. 2012).

This shift in scale has taken place within the context of broader trends in archaeology. It fits with a greater concern for local agency, for community and for everyday practice; and with the growth of phenomenological perspectives that encourage the situation of practices within particular places and landscapes. These are very positive developments. Indeed, Sorge & Roddick (2012), reviewing anthropological and archaeological research on mobility and multi-sited approaches, identify a focus on landscape as a strength of archaeology, in contrast to anthropology. This being said, we still need to find ways to ensure that the macro-scale perspective on movement and mobility is also maintained. In the shift from the circulation of artefacts to the practice of technologies, we need to allow for the *circulation of technologies*. Essentially, we need to find a way to tackle the macro, while keeping a micro-scale technological outlook. We have to keep this outlook, because whichever way we turn, we *do* see common technological practices across wide areas, or the introduction of novel technologies from one area to another, that point to the *mobility* of technology across space – whether in the ‘small-scale’ societies of the Neolithic and EBA, or the palace societies of the Late Bronze Age. But how are we to achieve this? How are we to recognise both local agency on the one hand, and on the other to explain broad regional trajectories such as Neolithic colonisation, Minoanisation or Mycenaeanisation (or even wider currents at the Mediterranean and European level)? It is not surprising that most of us focus on one scale or the other, or do both somewhat separately. The previous example of the

history of ‘archaeometry’/technology in Aegean prehistory bears testament to this, and shows how the difficulties in articulating different scales of analysis demand explicit consideration.

Biological Approaches to Scale

Most archaeological approaches that attempt to move across scales are either top-down, and so hence fail to do justice to the micro-scale (i.e. world-systems theory), or are bottom-up, and so suffer from the inverse problem (i.e. post-processual approaches). Neo-Darwinian evolutionary approaches, however, appear to promise an articulation of the micro and macro scales. Much of this work is aimed at diachronic evolution, which we will leave aside for now.³ When it comes to synchronic spread of cultural traits through and across communities, transmission studies take examples from contemporary society, such as dog breeds or baby names (Herzog et al. 2004; Mesoudi and Lycett 2009; Bentley and O’Brien 2011; O’Brien and Bentley 2011). These case studies seem quite convincing, as they do seem to get at the micro-level of individual choice and the macro-level of how these traits spread through communities. Yet these studies tend to select traits that only require the most basic kind of interaction for transmission. These cultural models have much in common with studies in epidemiological transmission for understanding the spread of infections (Bettencourt et al. 2006). Epidemiological models rely on simple characterisations of the virulence of the infection in question and the susceptibility of individuals in the population. The spread of a virus is similar to the spread of a cultural fad or fashion in that they both rely on little more than contact and susceptibility. The cultural models devised by Bentley and others (see above), working very often on the basis of random copying, deal with cultural traits that are quite easily transmissible, requiring little learning or skill. This renders the link between the micro and the macro seemingly straightforward.

Therefore such approaches can be critiqued for only having a theoretical and not an empirical grasp of what learning involves (Gosselain 2008; 2010). The ‘theory’ consists of “rather vaguely understood and crudely simplified abstract mechanisms” for how material culture styles are produced

³ Micro-level processes of transmission are identified, such as vertical and horizontal, generational and peer-to-peer. These are combined with longitudinal studies explaining cultural evolution over the long term. So perhaps they integrate micro-macro when looking over time (we will leave assumptions of random drift aside).

(Herbich and Dietler 2008). Epidemiological models may work for fads. But when it comes to cultural knowledge that requires apprenticeships and in-depth learning over time, then simple virus-like transmission models are probably not sufficient. Learning is “embedded in networks of social relations between individuals” (Coward 2008, 1494) ... and to this one might add, that it is often scaffolded around material artefacts and the very technologies themselves. This means that a simple notion of information transmission between two parties is insufficient.

A Situated Learning Approach

Darwinian approaches thus do not offer us a comprehensive solution to the problem of articulating the micro and macro scales in accounting for culture change; we need an approach more rooted in communities and learning (Knappett and van der Leeuw 2014). Artefacts can move from one place to another through exchange, perhaps involving only fleeting contact, and pottery styles can in many cases be readily imitated, but technologies usually require in-depth learning of skills, of the kind that cannot be so simply transferred. One has to think seriously about the kinds of knowledge implied and how they are constituted; and the more one does this, the more one has to think about the very real possibility of human mobility too, particularly mobile craftspeople. Itinerants, migrants and marriage networks: all kinds of scenarios present themselves.

So when we move from the micro-scale of the individual, to the meso-scale of the community, to the macro-scale of the ‘culture’, it is social networks that perpetuate learning and hence the sharing of technological practices. One of our respondents in this volume, Olivier Gosselain, has done extremely interesting work on this in west Africa, examining craft practices and their distribution at multiple scales (e.g. Gosselain 2000; 2008; 2010; 2011; Gosselain et al. 2008). Many archaeologists, especially those studying pottery, use his work extensively. This says a lot about his work of course, but it perhaps says more about how little we really understand of the social processes that link the scales of the individual, the community and the culture. Work on apprenticeship (e.g. Roux and Corbetta 1989; Crown 2001) certainly helps us grasp some of the dynamics at the micro-scale of learning, but how does knowledge acquired in this way find itself shared across wider scales? Gosselain picks out certain parameters such as the salience of a technique in the finished product, and the social context of learning; one might also in thinking about social networks consider the

frequency, fidelity, directionality and distance of the links. But we do need much more work on the vectors and contexts of learning. Gosselain himself reconsiders these influential ideas, published in 2000, underlining that it is not only transmission of knowledge that matters but thereafter its appropriation and reproduction through practice. What is acquired through initial learning/apprenticeship is not a “closed package” but “an open aggregate whose individual components are both constantly liable to be reassessed and modified, and enrich the repertoire of other practitioners” (Gosselain 2011, 219). These components can be reshaped or changed depending on the meaning they were charged with at the time of their transmission; this cannot be determined in advance but is context-specific and hence contingent. The biological approach generally fails to recognise this important point that learning is ongoing and “continuously reassessed” (Gosselain 2008, 154), rather than a bundle of information that is acquired at a specific moment. In this sense, then, learning is part of practice, rather than something that precedes practice.

A further dimension requires attention. If we take the map of Africa used by Gosselain to show social groups (Gosselain 2000, fig. 2), it is of course a geographical, physical space, but the emphasis is really on the distribution of social groups rather than the nature of the physical space per se. But we do also need to give some thought to the articulation of physical scales: technologies are learnt not just in social contexts but in physical settings too. An apprenticeship might very well play out in a particular landscape, with its own topography and resource distribution. A potter has to learn where the best clays are found, not to mention water sources and fuel. At this micro-scale, we can see well enough how a craftsperson’s skills are ‘embedded’ in a local landscape. But how does this knowledge translate into other environments? If technological practices are repeated across communities spanning multiple kinds of landscape, then how is the flexibility necessary for adapting to different environments captured within the technology itself? It would appear that we do need to think about not only the social context of learning, but also its physical context. Here we can speak of *landscape learning* (Rockman 2003).⁴ As humans live within a landscape, they develop knowledge about its resources, its limitations, ways to move

⁴ Marcy Rockman defines ‘landscape learning’ in terms of three kinds of environmental knowledge (Rockman 2003): 1. *Locational knowledge* that includes information relating to the spatial and physical characteristics of particular resources and is considered to be the easiest form of information to acquire; 2. *Limitational knowledge*, that refers to familiarity with the usefulness and reliability of various resources, including the combination of multiple resources into a working environment – it takes most likely at least a generation to develop such familiarity with resources as it depends upon the periodicity of the given resource and

around it or the right time to do things within it. But what does it mean to know an environment and how long does this learning take? And how can such knowledge be transferred from one individual or group to another? When one leaves an environment, what kind of knowledge does one take along, and how does one apply this knowledge in the new environment (see also [Chapter 12](#), this volume)?

So, in thinking about the mobility of technologies, we need to consider how technological knowledge is constituted, acquired, transferred, appropriated and reproduced – because this will influence how flexible it is in the unfamiliar landscapes inevitably encountered in human mobility. Though all kinds of subsistence and craft technologies are adapted to particular landscapes, some seem more readily transferred than others. Why is this? What cognitive features make for mobile technologies? Is it extended periods of learning? Scaffolded learning? A thorough articulation of the discursive and non-discursive? And of course there are social and political landscapes that may promote or hinder learning and mobility – see Shortland's chapter (this volume) on the non-mobility of certain technologies (glass, faience). One of the major challenges facing us is to find ways to combine and articulate the physical and social dimensions of space and mobility. Technologies move across both physical and social space, from one human community to another.⁵ Frequently the physical and the social will co-occur, such that the mobility in question is 'sociospatial' – but we need to think about these different aspects explicitly.

Volume Organisation

The volume has a regional focus of course – the Mediterranean – although here we see much more of the east than the west. The Mediterranean does seem to have particular qualities that throw technological mobility into sharp relief, with the hyperconnectivity enabled by the continental/maritime/archipelago topographies (see [Chapter 2](#), this volume). And our chronological focus is later prehistory, from the Neolithic through to the

its intended use; 3. *Social knowledge*, which is the collection of social experiences that serves as a means of transforming the environment or a collection of natural resources into a human landscape.

⁵ Some technologies seem to lend themselves to transfer and transmission across sociospatial boundaries more than others. Why? We can think about this in 20th-century contexts, such that some Western technologies have 'colonised' the developing world much more deeply than others ([Edgerton 2006](#)).

1st millennium B.C. The Fitch Laboratory approach to craft technologies is well represented (e.g. Kiriati, Georgakopoulou, Boileau), as are scholars who have been closely associated with its work (e.g. Knappett, Andreou), but our aim is to compare this approach with contributions from scholars in related areas. So, chapters by Andrew Shortland, and Andrew Bevan and Elizabeth Bloxam, provide an angle from Egypt and the Near East, while Urem-Kotsou's chapter provides a Neolithic perspective. Moreover, we have a chapter by Broodbank (author of *The Making of the Middle Sea: A History of the Mediterranean from the Beginning to the Emergence of the Classical World*), to provide the broader historical and environmental context for mobility in the Mediterranean and another one by Kristian Kristiansen (co-author of *The Rise of Bronze Age Society*, and *Organizing Bronze Age Societies*), who brings a very different, northwest European perspective on mobility. Furthermore, we have two commentary chapters: the first from Emma Blake, who has worked extensively in the west and central Mediterranean, and the second from Olivier Gosselain, who has recently co-edited a volume on cultural dynamics, and whose ethnoarchaeological work on pottery in west Africa we mentioned above.

Concluding Comments

What we offer here is an introduction to the volume; conclusions are for the readers to form themselves, prompted, we hope, by the responses of Emma Blake and Olivier Gosselain at the end of the book. Nonetheless, we can perhaps highlight here one or two issues which we think have arisen. It would seem that in many cases technological mobility is enabled by political elites – particularly when skilled artisans travel between quite distant communities. This we can see in the Late Bronze Age especially, with Minoan stonemasons probably travelling to Pylos and Mycenae (Bevan and Bloxam), and Minoan potters and fresco painters to Akrotiri (Nikolakopoulou and Knappett). In the light of this kind of evidence, Kristiansen's argument for a new kind of political economy in the Bronze Age – in which considerable mobility was driven by the trade in metals, often couched in political alliances – seems convincing. For this new 'value system', Kristiansen sees technologies of mobility and warfare as particularly important, with mobile traders, mobile warriors (as institutionalised roles) – and perhaps even mobile artisans? – holding significant power. And yet, this risks creating something of an all or nothing scenario, where elites and their technologies are mobile, and non-elites stay still. To start with,

not all elite technologies necessarily travelled – glass beads were elite items on the Mycenaean mainland, yet although they were manufactured there, the glass ingots themselves were always imported from Egypt or the Near East (Shortland). Second, there is mobility among non-elites too. Kiriatzis and Andreou argue, for example, that although the conditions of the ‘new world’ of the Late Bronze Age may have been largely generated by elite desire for metals and exotica, not all mobilities are directly related to elites. Their technological analysis of Mycenaean pottery in central Macedonia shows that some of it was produced locally, but using techniques (such as the potter’s wheel) that were not part of local traditions. This indicates some mobility of potters trained in southern Aegean methods but practising their craft in Macedonia and, similarly, in other areas of the central and east Mediterranean. So this suggests regular inter-regional mobility quite apart from any elite involvement. Third, in a reversal of this pattern – in that hand rather than wheel techniques are associated with mobility – Boileau shows that, in the crisis at the end of the Bronze Age, Handmade Burnished Ware was well-suited to immigrant groups on the move, being handmade and low-fired and thus not demanding any investment in kilns or wheel devices.

And even if we were to imagine some sort of coherency to value systems in the Late Bronze Age, does this mean that earlier periods were fundamentally different? Georgakopoulou shows us that in the Early Bronze Age Aegean there is nothing to suggest elite control over metal resources, and yet there is a great deal of mobility as artisans seek out sources and suitable places for smelting away from settlements. There seems to be some degree of shared technical knowledge, with perforated furnace walls a widespread feature, but also a good deal of technical variability from area to area too. For the Neolithic, particularly the Middle to Late Neolithic transition in northern Greece, Urem-Kotsou warns against the simple equation of material culture change with the arrival of new populations. And yet, with a more nuanced approach to mobility, and the careful tracking of material movements, from shell, to lithics, to ceramics, one can build up a picture of complex mobilities, with all kinds of regional and inter-regional networks of artisanal knowledge. Broodbank too, though focused in part, as Kristiansen, on technologies of mobility (especially seafaring), offers us this longer term perspective by considering both the Neolithic and Bronze Age, and making it clear that mobilities have this very deep history. Which raises the interesting point, we feel, of whether the changes from Neolithic and Early Bronze Age to Late Bronze Age, with the emergence of ‘complex society’ – and all that typically entails for what we think of new hierarchies

and specialisations – are changes of degree or of kind. Does the Bronze Age have such a huge impact on technological mobilities, because political elites provide both the ends and the means for technological transfer (see Blake, this volume)? Or were such mobilities present much earlier, even in more egalitarian communities?

These kinds of questions require us to examine much more closely the economic, social and political factors that might motivate and enable the mobility of technologies. Archaeology can certainly benefit from engaging with theory in the humanities and social sciences more broadly – and recent thinking on globalisation and mobility has been especially beneficial in work on ‘-isations’, as discussed by Versluys (2014) for Romanisation. Furthermore, we can also trace interesting applications of such ideas in historical archaeology (e.g. Hauser 2011) and Mesoamerican archaeology (Halperin 2014), in conjunction with specific classes of artefacts. What we hope the case studies assembled here provide are ample evidence of the benefits of creating detailed case studies to think through the relations between different forms of mobility, whether human, artefactual or technological. Moreover, we also believe that these chapters show the rich potential of the Mediterranean as an arena for future investigations of the long-term trajectories of technological mobilities.

The Transmitting Sea: A Mediterranean Perspective

CYPRIAN BROODBANK

Abstract

The prehistoric Mediterranean provides an unusually, if not uniquely, favourable environment for human mobility and the exchange and spread of technologies, as well as exceptional conditions for the archaeological investigation of such phenomena. This chapter explores why, and also offers a long-term perspective on changes in technologies of mobility, especially at sea in the form of boats. It closes with some thoughts on the fundamental importance of a demographic perspective on the core issues analysed in this volume, both at a macro and micro level.

Archaeologists who study interaction and technology within the prehistoric and later Mediterranean tend to take its advantages as an investigative theatre very much for granted. On the face of it, there is good reason to do so. For, as an endless stream of specialist and wider interpretative publications testify, the Mediterranean provides one of the most successful arenas for such studies on the planet, and indeed arguably the best of all in terms of prehistoric trade and mobility. Yet it is surprising how rarely we stop to ask ourselves why this should be the case in what is, after all, a relatively small patch of the Earth's surface – beyond, of course, the part played by cumulative scholarly momentum over several centuries, which has bequeathed one of the most intensively investigated, data-rich archaeological records anywhere. The answers to this first question should prove of some interest to Mediterranean archaeologists and historians, but also advance the goals of an explicitly comparative 'thalassology' that sets out to explore the roles of seas in general as effective conveyors of people and culture (on a thalassology of the ancient Mediterranean, see [Horden and Purcell 2006](#)). With some working ideas as to why the Mediterranean is so productive in this regard established, this chapter moves on to investigate the growth of technologies of mobility over time in the Mediterranean, from the Pleistocene

My warmest thanks to Evangelia Kiriati and Carl Knappett for the invitation to participate in an exceptionally stimulating workshop in Athens, and for their patience thereafter.

to the Iron Age, both those with a direct impact on movement (primarily shipping) and some of those less directly but still intimately implicated in mobility and transmission. Finally, this chapter advocates a demographic perspective on such questions, at a pan-Mediterranean level, but also a microcosmic scale, and with special regard for the typically modest, indeed often tiny, groups, highly selectively sub-sampled from their parent populations, that undertook much of the contact and exchange that drew the early Mediterranean world together and brought it into being.

Mediterranean Advantages

Several elements in fact combine to make the Mediterranean an unusually favourable theatre for interaction and transmission, as well as their archaeological analysis. Once maritime connections were enabled by the development of seagoing vessels, inland seas started to provide some of the most stimulating environments for such activities to flourish, and the Mediterranean is in this regard a planetary leader, dwarfing its neighbours, the Black and Red Seas, as well as the Persian Gulf and the Baltic, while competing with analogous spaces further east and in the Americas (Broodbank 2013, 60–2). Moreover, size is not everything, for the Mediterranean's coastal and archipelagic topography is also unusually complex, creating an often involuted maritime interface some 46,000 km in length, and one hugely conducive to movement over sea between patches of land (Grenon and Batisse 1989, 31–3; Broodbank 2013, 75–9). Within certain parts of the Mediterranean, notably the semi-enclosed Aegean, Adriatic and Tyrrhenian sub-basins, the fractal properties of coastlines are notably pronounced, thereby creating similar sets of potentially catalysing spatial conditions at a series of scales (on Mediterranean fractal properties, Korcak 1938; Malkin 2003, 57). An excellent example of this last propensity is the Saronic Gulf, a region well known to prehistorians and Iron Age archaeologists alike for spawning the serially precocious trading island communities of Aegina, and one that is both a mosaic of even tinier versions of itself, and a miniature variant of the enclosed, island-studded Aegean, which in turn echoes in an unusually intense form the overall configurational properties of the Mediterranean. As if this cluster of positive features were not enough, the Mediterranean also constitutes the largest extent on the planet of the eponymous category of semi-arid environment, the other areas technically defined as 'mediterraneanoids' being located in southern California, central Chile, South Africa and two discrete zones in southern Australia

(Blondel et al. 2010, 72–6; Broodbank 2013, 61–2). The relevance of this point to the theme of this volume is that such environments are inherently risk-prone and so tend to promote interaction further, as a buffering and collective pooling mechanism (such conditions can, conversely, also richly reward successful risk-takers and so precipitate aggrandising individuals or groups; on risk-buffering and its consequences, Halstead 1988; 1989; Horden and Purcell 2000, 178–82; Broodbank 2013, 66–7, 19–20, 264–5). In consequence, many Mediterranean networks were primarily constructed simply to keeping life ticking over reasonably reliably. A growing amount of evidence suggests that this general environmental regime became prevalent across much of the basin 5,000–6,000 years ago, following a predominantly lush early Holocene (Broodbank 2013, 262–8, with full references). From this time on, the resultant, and all but unique, concatenation of Mediterranean maritime and environmental conditions rapidly promoted dynamic social developments in a several widely separated hotspots.

Another strongly contributing factor is the Mediterranean's longitudinal east–west alignment, a relatively rare feature among inland seas. This rendered the transfer and local uptake of innovations requiring similar environmental conditions relatively straightforward, notably those directly associated with farming or stemming indirectly from its products, such as the social and technological practices involved in oil-based perfume use, wine-drinking symposia or weaving of woollens and linen. Once such ways of doing things became widely disseminated, and regular interaction between constituent parts of the Mediterranean was established, the economist Ricardo's Law of Comparative Advantage began to operate on an ever wider scale, promoting product specialisation and further boosting trade (for applications of Ricardo's thinking to Bronze Age temperate Europe and the Mediterranean, respectively, see Shennan 2002, 165–8; Sherratt and Sherratt 2001, 23). Contrast all this, for instance, with the Baltic (commonly touted as the Mediterranean of the north – a compliment rarely, if ever, reversed, as recently pointed out; Horden and Purcell 2006, 726), which runs from the plains of temperate central Europe to the fringe of the Arctic Circle, through a spectrum of intervening ecotones. Even the Baltic's one major compensating strength in this respect, that of a complementarity of resources between its internal regions (e.g. northern furs for southern grain), is matched in a different way in the Mediterranean, too, where such differentiated zones tend instead to be vertically stacked, from the seabed to mountain peaks.

The geological processes behind this last feature in turn lead on to one final promoter of interaction and craft mobility, namely the Mediterranean's

diversity and super-abundance of raw materials, which is likewise a consequence in large part of its violent tectonic formation through processes of crustal uplift and fragmentation (Ruffell 1997; Woodward 2009 for the overall physical geography of the Mediterranean). This is true even in terms of biology, where the constant break-up of landscapes over deep timescales explains exceptional rates of speciation and resultant endemism, which in turn created plants and animals with unusual properties, some of which became highly prized (for biological perspectives, see Grove and Rackham 2001; Blondel et al. 2010). The best example is the now-extinct Libyan plant known as silphion, whose culinary and medicinal properties contributed substantially to the wealth of Cyrene (which portrayed its bulbous, fennel-like form on its coinage), so much so that over-harvesting is thought to have led to its eradication (Horden and Purcell 2000, 65, with references). But the result is even more evident in terms of mineral distribution (Kassianidou and Knapp 2005, 218–30; Broodbank 2013, 68–70, fig. 2.6; in the eastward extension of this arc, see Janković and Petraschek 1987). It is not simply that the Mediterranean is extremely rich in metals, stones with various useful or attractive properties (often volcanics from the back-arcs of the tectonic clash), clays, rare soils and other wonders. This it holds in common with much of the eastward extension of the arc of mountain-building that continues as far as the Himalayas.

More significant is their spatial unevenness, along with other characteristics of their distribution. At a pan-Mediterranean scale this is marked by a divide between the poorly endowed southern shore (to simplify, the sub-ducted, diving, African plate) save along the Nile corridor, and the far more mineral-rich northern and (to a lesser extent) eastern flanks. But even along the European and western Asian sides of the Mediterranean, there are marked differences between the polymetallic wealth of the uplifted highland zones at either end of the Mediterranean, in Iberia and Anatolia, on the one hand, and basically monometallic Cyprus, one of the richest copper sources in the world, let alone areas such as southern Italy, which possess few if any such resources – while an oft-made further observation is the fact that most, if not all, of the tin used as a constituent in early bronze production came from beyond the basin (Pare 2000). The various products of volcanic zones were even more restricted in terms of outcroppings, and in the case of obsidian to less than a dozen largely point sources in and immediately surrounding the basin. The case of obsidian is equally remarkable because all the sources within the basin proper are located on islands, access to which necessarily implied seagoing. Furthermore, this insular concentration reflects in an extreme form a wider truth, namely that many of the most desirable ores and stones

are found in broken-up, remote and otherwise spatially or environmentally marginal areas that required arduous travel to exploit, including high mountains, uplands and peninsulas as well as true islands. Mineral-rich zones in close proximity to lush prime arable lowlands are a rarity, the principal exceptions being Etruria (where, however, it did not promote a notable take-off in social trajectories until surprisingly late, in the Iron Age), and arguably the southwest Iberian Huelva mountains paired with the valley of the Guadalquivir. The overall result was what Braudel, in his own prehistory of the basin, nicely termed the ‘imbalances productive of exchange’ (Braudel 2001, 58).

So much for the intrinsic advantages of the Mediterranean as a promoter of human mobility and transmission. But there is no doubt that these advantages are also exceptionally clearly archaeologically visible. Much of this is due to the same kind of mineralogical diversity that we have just examined: the peacock colours on geological maps of the basin. Obsidian offers, once again, a thought-provoking case in point. The discovery of Melian obsidian in terminal Pleistocene strata at Franchthi Cave used to denote the oldest known seagoing by modern humans anywhere in the world, and although long overtaken by southwest and northwest Pacific data (intriguingly, some of it derived again from movement of obsidian), the different early dispersal horizons of Aegean and central Mediterranean obsidian still tell us much about decisive phases in the intake of each maritime realm (Perlès 1987, 142–5; Broodbank 2006, 208–14; 2013, 152–4, 182–4; for the Pacific data see Spriggs 1997, 58–9 and Habu 2010, 161). But equally, our continued uncertainty as to the extent of early seagoing in the westernmost stretches of the Mediterranean, around Iberia, the western Maghreb and the Balearics, is in large part due to the lack of a convenient tracer in the form of an obsidian source west of Sardinia, or substantial finds of Tyrrhenian obsidian west of France. Local geological diversity, combined with a multitude of short, steep gradients pitching into discrete catchment regions, is also responsible for much of the success of ceramic provenancing in the Mediterranean, especially through petrological analysis of clays and their inclusions. For instance, the abundant micro-level insights afforded through analyses of this kind by the Kythera Island Project would have been a lot less informative without the coexistence within one moderately sized island of two totally different geological units that generated clays and fabrics with strikingly different properties easily visible to the naked eye, plus the lack of any close equivalent to one of these units anywhere in the surrounding southwest Aegean (Kiriati 2003; Broodbank and Kiriati 2007). The exemplary success of ceramic provenancing throughout the

Mediterranean is due to a combination of factors, including a very high investment in pottery by most Mediterranean societies, which adopted it as the primary medium for creating vast numbers of dry storage and liquid transport facilities, as well as food preparation and consumption vessels; but it is surely also a reflection of nigh-perfect geological conditions.

We can venture one final observation concerning archaeological visibility. In comparison to the otherwise not entirely spatially dissimilar maritime world of Island Southeast Asia, where most of the prized trade-goods were perishable organics (for example, spices, sandalwood, birds-of-paradise and sea cucumbers; for the Southeast Asian analogy, see also [Sherratt and Sherratt 1998](#), 338–9), there is a strong sense that many of the principal elements in the Mediterranean, albeit chosen for their colour, texture, working or use properties and suchlike as much as their durability per se, were mineral-based and therefore have a greater chance of survival – for all the admittedly severe problem of metal recycling. Moreover, several that survive less well travelled in durable ceramic containers ([Bevan 2014](#)). The obvious exception, of course, is textiles, but even here another Mediterranean advantage comes into play: namely the region's proximity to the Near East and Egypt, which ensured that at least adjacent parts of the basin possessed written archives from an early date, whose itemised records go a long way towards compensating for, and evening up, such imbalances in relative survival ([Barber 1991](#)). In a sense, returning to materiality, the number of extraordinary one-off preservation contexts that defy attrition and dramatically enrich our sense of the original range of goods used in the past – pre-historic Pompeii in Campania and the Cyclades, dry caves full of basketry and much else in Israel and Spain, shipwrecks and waterlogged villages all around the coast and other aquatic zones, and even an Iceman in the overlooking Alps – reflect a peculiar combination of freak conditions that owes much to the diversity of the Mediterranean as a theatre ([Broodbank 2013](#), 29). In how many other areas around the world do volcanism, ice, desiccation and water saturation coexist in such proximity? In summary, the Mediterranean is without doubt one of the most privileged places on the planet in which to investigate early movement, which in turn underpins much of the project to understand the parallel mobility of technologies.

Technologies of Mobility

To create a Middle Sea even from such auspicious conditions also required, however, the means to move about within and across the Mediterranean, so

while other chapters in this volume focus on mobile technologies, it may be useful here to investigate the nature and spread of technologies of mobility. Throughout prehistory and well into Classical times, developments in terrestrial movement beyond the pedestrian were very few. The most significant process was undoubtedly the domestication of donkeys and their spread as pack animals, whether for individual use in localised landscapes or their long-range deployment in large caravans (Brodie 2008; Rossel et al. 2008; Broodbank 2013, 288–9; Marshall and Weissbrod 2011). Once again, the Mediterranean proved lucky, this time in its proximity to the north-east African epicentre of domestication, and by the later 4th and 3rd millennia BC donkeys became naturalised in the Levant, reaching the Aegean by the end of the latter millennium, at the latest, and parts of the central Mediterranean a thousand years later – the timing of their eventual spread to Iberia and (as a domesticate) northwest Africa is at present still poorly resolved. Up against this flexible, high-endurance beast, the early use of carts and wagons (a more obviously technological development that diffused over a not dissimilar time-span but from a less unambiguous centre) was limited by the presence of seas and uplands to short-range transport. It proved vital to the mobilisation of bulk crops by urban centres, via networks of local trackways (such as those visible from space radiating out from 3rd millennium BC towns along the Syrian saddle, or those later examples detected on the ground in the hinterland of Mycenae), but had little impact on further horizons (on such trackways, see Jansen 2002; Ur 2003).

Far more decisive, unsurprisingly for an inland sea, were developments in maritime technology, along with their social implications, transmission and overall uptake and expansion. As I have explored these issues in some detail in previous papers (Broodbank 2006; 2010, with full references for the following discussion; also Broodbank 2013, 596–7, fig. 11.1), the present discussion offers a more succinct summary, focused on the key changes in performance and what they enabled, before moving on to a brief consideration of co-mobile technologies and related phenomena.

The deep-time background to Mediterranean maritime activity is an immense period of very basic short-range and probably only episodically realised seagoing. The earliest absolutely bona fide evidence for this kind of activity comes from an otherwise undated horizon within the Aurignacian, when people made a relatively brief incursion into Sicily, followed by a presence on Sardinia (or rather the conjoined Pleistocene mega-island of Corsardinia) around the Last Glacial Maximum. In both cases the protagonists were modern humans. Claims for much older seagoing, on the part of Neanderthals and even antecedent ancestral species, have so far fallen

just shy of decisive proof (most recently, [Strasser et al. 2010](#)). More disturbingly, they have displayed a tendency to extrapolate social and cognitive implications far beyond what the evidence can sustain, which (if verified) is in technological terms only marginally beyond what Nature's sweepstakes might achieve through current, wind and flotation. Occasional such events are not intrinsically implausible given the Mediterranean's configuration, its populations of intelligent hominins, and hundreds of thousands of years for the odds to be played out. But the frequency of any such activity was palpably much too low to have any significant impact in terms of reducing the Mediterranean sea's primordial role as a divider rather than uniter of the people living along its shores. Europe's Neanderthals offer the starkest proof of the truth of this assertion, both in the fact that the speciation that led to their differentiation from the modern humans emerging simultaneously in Africa is unthinkable without a more or less completely impermeable barrier between the two, and because there is absolutely no sign of contemporary interaction across the strait of Gibraltar, despite the fact that the Rock constitutes one of their most intensively investigated long-term habitats (on the Gibraltar Neanderthals, [Barton et al. 2012](#); more generally [Hublin 2000](#); [Broodbank 2013](#), 96).

In archaeological terms the best-known instances that mark the inception of a more proficient and extensive approach, one that can be reasonably thought of as 'seafaring', are the Melian obsidian at Franchthi and the earliest human arrivals on Cyprus, both now datable to the 11th millennium BC and necessitating longer single or sequent sea-crossings ([Simmons and associates 1999](#); [Broodbank 2013](#), 148–56). No images or boat remains exist from this phase, nor for several millennia to come. Quite possibly, the craft used were similar to those of at least the earlier Upper Palaeolithic, and simply reliant on the principle that a craft afloat after a day will probably be so after a week or even a few months; save for a few hints of pig-stocking on Cyprus, there is nothing in the hints of cargoes that we can detect to suggest bulky or perishable goods beyond the passengers (for the possible stocking of Cyprus with wild pigs, see [Vigne et al. 2011](#)). By the early Holocene, at the latest, however, a similar degree of medium-range proficiency in sea travel between mainlands, peninsulas and true islands must have become married to a reasonably robust and protective boat technology, almost certainly in the form of dug-out canoes, the remains of a lacustrine variant of which survive from 6th-millennium BC Lake Bracciano in central Italy ([Fugazzola Delpino and Mineo 1995](#)). The primary reason for inferring this is the wide dissemination of propagules of farming, and in many instances clearly the farmers themselves, from one end of the basin

to another between the 9th and 6th millennia BC. Mediterranean crops and domestic animals are fairly bulky and non-aquatic (Broodbank 2013, 184–96). At least one stowaway commensal of early Levantine farming, the house mouse, spread with them, certainly as far as Cyprus and possibly at this stage already on to Crete (Cucchi et al. 2005). This capacity for transfers of modest cargoes over medium ranges (up to about 60–70 km of open sea, for perhaps a couple of days in terms of journey time) appears to have established a fairly stable performative threshold for most of the remainder of the Neolithic, and is sufficient to account for the majority of the attested circulation of stones and other materials by sea within sub-basins, as well as most of the growing peopling of island spaces.

Two separate new developments finally punched through this maritime ceiling during the later 4th and 3rd millennia BC, itself a period of decisive importance across the Mediterranean in terms of rapidly growing social inequalities and inter-regional connections (for an overall interpretation of this ‘long’ 3rd millennium BC, Broodbank 2013, 257–344). Intriguingly, it is questionable how much the initially most widespread of these changes really owed to a substantive technological as opposed to ideational innovation. All over the Mediterranean, there are signs of a sharp rise in the range of crossings at this time, measured by access to hitherto remote islands, links between formerly segregated zones and transfers of low-bulk but socially charged goods and shared symbols over very long distances – the ‘beaker’ connections of the western Mediterranean and the ‘international spirit’ of the Aegean being excellent examples (Broodbank 2010, 250–54; 2013, 325–39; also Rahmstorf 2008; 2010a). Despite occasional appeals to the supposed likelihood that this horizon reflects the uptake of fundamentally new, sail-driven sea-craft (e.g. Maran 2007, 7), there is in fact, for the first time, substantial iconographic evidence (itself an index of the enhanced ideological role of seafaring) for precisely the contrary. In the Aegean, on Malta, and slightly later elsewhere in the central Mediterranean, the vessels shown are of a long, slender, paddle-driven design, probably plank-extended versions of the traditional canoe technology with, we can infer from ethnographic comparanda, a rather better turn of speed but only slightly greater cargo capacity (Broodbank 2000, 96–106; 2013, 327–9). The mariners who set out on what must often have been extremely dangerous voyages in such craft were undoubtedly lured by a new social currency for faraway things and knowledge, but in practical terms they were simply pushing to its logical extreme the limits of the possible with a very old, pre-existent way of designing things.

The sail was in the long term a far more profound game-changer (Wachsmann 1998; Broodbank 2010, 254–60; 2013, 290–92, 373–5,

464–6). The result of harnessing the wind as a supplement to, or replacement for, human muscle-power was ships several times faster than paddled vessels. Given that the Mediterranean answer to the problem of stability posed by a tall mast was a broader, deeper hull, rather than the outrigger or dual-hulled designs favoured by early sailors in the Indo-Pacific, it also went hand in hand with the ability to hold and move around vastly more cargo. Sails shrank the Mediterranean, enabling the distinctive regime of swift, long-range bulk transport to take off, and vastly increasing the scope for the direct, high-fidelity transmission of information and ways of doing things; ultimately, it is impossible to imagine the Mediterranean world of interconnected cities on the sea, fed by dispersed hinterlands, without them. Yet the empirical evidence suggests that the advantages were far from immediately obvious, or at least far from universally adopted, despite the certainty of a bow-wave of interloping examples engaged in trading and raiding. Rather, the expansion of imagery of early sailing craft plots a westward uptake over almost 2,000 years, from the earlier 3rd millennium BC on the Nile and by inference along the Levantine coast, to around the start of the 2nd millennium BC in the Aegean, probably the last few centuries of the same millennium in parts of the central Mediterranean, and around or just after its very end in the far west. That this apparently somewhat staid process broadly mirrors a take-off in social complexity in each region strongly hints that the major retardant was the need for the substantial capital investment to sponsor such craft, and overall conditions of social flux amenable to the overthrow of older maritime practices, plus their social correlates, in favour of a new, tightly interconnected package of constructional, navigational and socio-economic practices. Only by the end of the 2nd millennium BC were the conditions right for sailing to become a truly pan-, as well as trans-, Mediterranean practice, and the swift upshot was the phenomenon that we somewhat simplistically call ‘the Phoenicians’ (Broodbank 2013, 482–95).

Ship-building technologies did not, of course, emerge in a sealed bubble, but co-evolved through the 3rd to early 1st millennia BC with a series of other innovations. It is interesting to note that among these were almost certainly not new navigational mechanisms; in the relatively confined and seamount-rich waters of the Mediterranean, the vital acquisitions, instead, were knowledge of long sequences of route markers (the oral origins of the later written periplous tradition) and, as ultra-long-range open-sea travel along the basin’s island-rich spine took off in the late 2nd millennium BC, the celestial expertise to maintain course at a given latitude by night (for the former, Gell 1985; Horden and Purcell

2000, 124–30; on the latter routes see [Aubet 2001](#), 168–70, and for the medieval period, [Pryor 1988](#), 14 fig. 2, 91–5). Other kinds of shipboard equipment vital to the transfer and convergence of practices have already been expertly discussed by Monroe (2009, 39–56), notably the sets of balance weights that allowed shipboard merchants to conduct trade so effectively, and to such advantage, in foreign ports.

Less often emphasised in the Bronze Age, as opposed to its general recognition in the Iron Age, is the potential link between seaborne movement and the dissemination of writing systems (on this theme during the Early Iron Age, [Sherratt 2003a](#)). This is largely due to the static model of writing encouraged by the archaeological preponderance of massive clay archives in the Bronze Age of the eastern Mediterranean – a situation transformed at the end of the 2nd millennium BC by the wide uptake of largely non-surviving papyrus. But in fact even clay tablets moved over long distances, most famously in the case of the 14th-century BC Amarna letters, which were read aloud at foreign courts, while the find on the almost contemporary Uluburun shipwreck of a wood and wax folding writing board opens up considerable possibilities for the spread of ‘jotting’ scripts, probably linear and sometimes possibly proto-alphabetic as opposed to cuneiform (on the Amarna letters, [Moran 1992](#); on the Uluburun board, [Bass 1990](#); [Payton 1991](#)). It also makes the appearance of a Cretan-related script on Cyprus, and scraps of related signs in the Levant, far more comprehensible ([Finkelberg 1998](#); [Ferrara 2012](#)). Indeed, if we possessed more of such interstitial writing, the division of east Mediterranean writing systems into several terrestrially defined, clay-based discrete varieties might seem less neat.

Once one begins to look for connections, other possibilities also start to present themselves. There is, for example, a striking temporal correlation in the Aegean between the uptake of the sail and that of pot-bellows for metallurgy¹ – two parallel harnessings of the movement of air. And lastly, long before long-range amphibious violence came fully of age with the combination of trireme and hoplite, it is hard not to discern a connection between the likely spread of sailing technology into the central Mediterranean in the last centuries of the 2nd millennium BC and the subsequent blow-back east of the so-called ‘Sea People’ phenomenon (for a recent interpretative summary, [Broodbank 2013](#), 460–72, 475–7).

¹ I am grateful to Roger Doonan for discussion of this matter.

The Demographics of Transmission

The last example above points towards the final theme explored in this chapter, namely the critical importance of a demographic framework when considering Mediterranean networks, issues of production, consumption, innovation, adoption and transmission. Without order of magnitude estimates of the numbers of actors involved it is actually very hard to conceptualise and try to model such processes and people at work. Two sets of figures can forcefully illustrate this point. The first registers the drastic nature of population growth between the Last Glacial Maximum, when plausible estimates suggest a basin-wide population of no more than some 45,000 people, and the height of the Roman empire, when the number of inhabitants was approximately a thousand times larger (fuller discussion in [Broodbank 2013](#), 122–3, 578–9; [Scheidel 2007](#), 42–8, table 3.1). How many of these people moved around at any one time, and over what range is, of course, even harder to determine, but there is little doubt that the aggregate trend once farming had settled in was upward in relative and absolute terms, with a marked acceleration as sailing ships brought faster, lower cost travel to more and more parts of the basin. In this sense, the key difference between the Iron Age Tyrrhenian trading hub of Pithekoussai and its Bronze Age predecessor at Vivara was a gigantic demographic one, with thousands of people now flowing through. (The scale of the Pithekoussan mobility is noted by Osborne 1996, 40–1.) The second comparison, again only in approximation, underscores the massive inequalities in contemporary demographic build-ups within the basin. These had always existed to some degree – during the Neolithic, for example, vortices such as Thessaly and the Tavoliere present a quite different prospect from the thinly settled or empty lands around them ([Robb 2007](#) for Neolithic southern Italy). But by the 2nd millennium BC, after a thousand years of urban growth in the east and before the centre and west had begun to catch up, the scalar inequalities had grown, with the largest of the cities in the former zone (places such as Avaris, Hazor and Knossos) boasting populations of 20–30,000+ that were equivalent to those of entire regions or substantial parts of even the largest islands in the centre and west ([Broodbank 2013](#), 383–6, 415–16; for Knossos, [Whitelaw 2012](#), 150 table 4.1).

But demographically informed thinking is also helpful for issues of mobility and technological transmission at a very small scale. One at least heuristically useful question to ask is which members of a given community of craft experts might go mobile, with what degree of freedom, and from

what strata of society? Here we can anticipate a lot of variation, for example, between a high-status female member of the elite, secondarily also skilled in weaving, an unfree, attached hyper-crafting expert in metal, stone or multimedia products sent abroad at the behest of a royal master, or a potter less successful, perhaps, than his peers within a relatively independent potting community. What could or should we infer from the archaeological signature of each, in terms of craft and status? Another approach is to emphasise the disproportionate impact on transmission of often small-scale, if not tiny, mid-way populations, notably those of any islands in the stream at any given juncture, and the crews of the floating, mobile islands that we call sea-craft. In this vein, for example, Susan Sherratt has recently focused in on the minute sub-set of Levantine societies that appeared as traders in the Aegean during the early centuries of the 1st millennium BC, and whose behaviour, characteristics and values determined what Greeks would bring together to create the 'Phoenicians' encountered in the *Odyssey* (Sherratt 2010). Thinking very small, at the level of the decision-making individual in the past, or that of the microscope today, as well as very big, in terms of the overall affordances of the Mediterranean theatre, will both prove to be essential if we are to make the most of the unique opportunities and insights that the archaeology of this Middle Sea presents.

3 | Changing Pottery Technology in the Later Neolithic in Macedonia, North Greece

DUSHKA UREM-KOTSOU

Abstract

This chapter discusses the generation of innovation in early Late Neolithic ceramic technology. It is suggested that competition between individuals and groups expressed in the context of conspicuous consumption had a dynamic role in the formation of the new Late Neolithic (LN) pottery tradition. Mobility of people and various materials must have facilitated the dissemination of novelties.

Movement of people has traditionally been widely used, and still is to some extent, as the main explanatory mechanism for cultural changes. According to the diffusionist approach, material culture was understood passively as an indicator of the cultural and ethnic identity of its producers and users. In Greece, this approach is well illustrated by interpretations of the beginning of the Neolithic ([Perlès 2001](#) and references therein). The widespread appearance of an entirely new pottery style at the beginning of the Late Neolithic¹ in the Balkans has also been interpreted in such terms, as evidence of new populations that carried the new tradition with them from Anatolia ([Babić and Tomović 1996](#); [Chapman 2006](#)). In more recent approaches to cultural change, however, diffusion and migration have been avoided as an explanatory mechanism, and emphasis is placed on economy and agency as vehicles for the changes observed in the course of the Neolithic in Greece. An active role has been recognised for the movement

I wish to thank the editors for inviting me to contribute to this volume and for tolerating repeated delays in submitting the manuscript. Special thanks to Professor Paul Halstead for critical comments on the manuscript, as well as to the editors and to two anonymous reviewers for valuable and useful suggestions. Fotis Ifantidis is thanked for providing me with literature on the *Spondylus* ornaments.

¹ The chronological framework for the Neolithic period followed in this chapter is taken from [Andreou et al. 2001](#): Early Neolithic (EN) 6700/6500–5800/5600 BC, Middle Neolithic (MN) 5800/5600–5400/5300 BC, Late Neolithic (LN) 5400/5300–4700/4500 BC, Final Neolithic (FN) 4700/4500–3300/3100 BC.

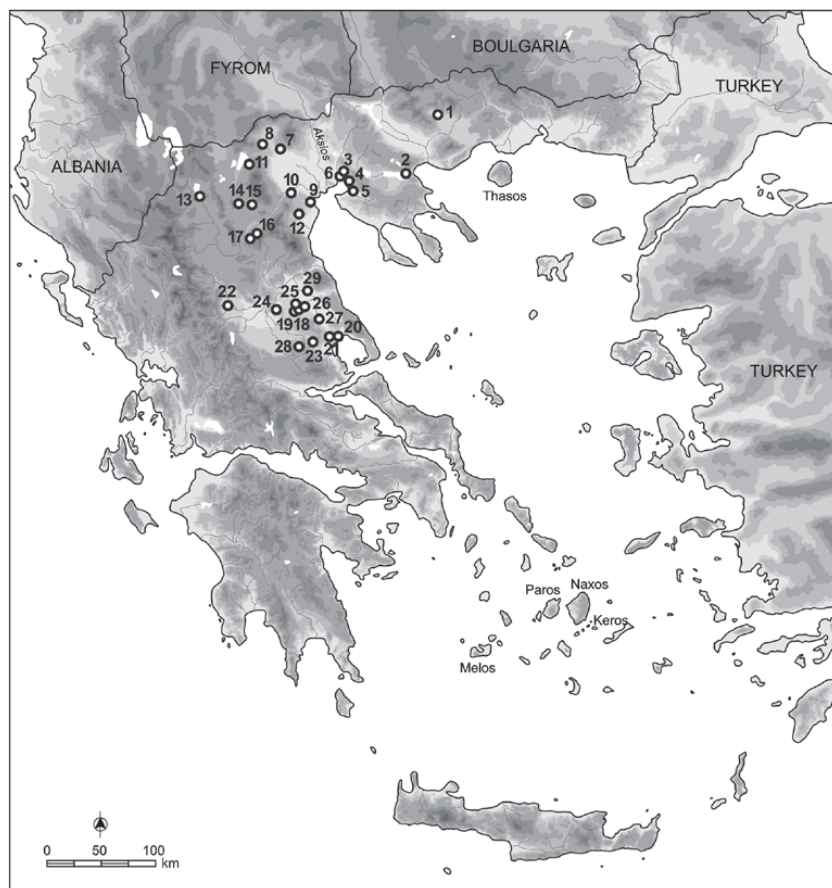


Figure 3.1 Map of the Aegean showing location names mentioned in the text (drawn by Nikos Valasiadis).

of people, products and ideas in shaping material culture and social conditions, but in a rather different way than was previously proposed.

In this chapter the appearance of the new pottery tradition that marks the beginning of the LN in Macedonia (northern Greece) is discussed in terms of the conditions that allow the generation of innovations, and their appropriation and incorporation into local traditions. To this end, aspects of LN pottery production and consumption will be discussed in comparison with the production and consumption of pottery in the preceding Middle Neolithic (MN). It should be stressed that information on Neolithic ceramic production and consumption in Macedonia is still quite limited, since the study of pottery usually focuses on typology and rarely includes vessel technology. Available evidence comes from several

recently excavated sites in central and western Macedonia where the study of pottery focuses on both vessel production and consumption. Additional information on MN and LN pottery production comes from re-study of pottery from old excavations in Thessaly, since pottery technology has been more systematically studied in this neighbouring region (Figure 3.1).

Northern Greece in the Neolithic

In the course of the earlier phases of the Neolithic in Greece, changes in pottery and other aspects of material culture appear to be gradual. At the end of the MN, radical changes occurred, particularly in pottery, marking the beginning of the LN. Changes in material culture have been related to changes in production and consumption practices, and the social organisation of Neolithic communities, as inferred from settlement pattern, intra-site spatial organisation and increased variability in vessel style (Halstead 1989). Based on the archaeological record primarily from Thessaly, it has been suggested that early agricultural settlements were typically small villages, compatible in size with 'egalitarian' communities, but with increasing evidence during the MN and especially LN for internal competition. During the Final Neolithic (FN), habitation aggregated into larger nucleated settlements, perhaps enabled by the emergence of institutionalised social inequality (Halstead 1995; Kotsakis 1999; Andreou et al. 2001).

Networks of exchange and movement of craftsmen, middlemen, craft products and raw materials must also have played an active role in shaping and changing the social reality of Neolithic northern Greece, as investigations in Thessaly suggest (Halstead 1989; Perlès and Vitelli 1999; Pentedeka 2009; Pentedeka and Dimoula 2009). Thessaly is exceptional, however, in the wealth of information available for all periods of the Neolithic. Evidence for the earlier Neolithic periods in other regions of northern Greece is still quite scarce, despite the growing number of excavated sites. Later phases, however, are better known. Based on the available archaeological evidence, settlement patterns and intra-site organisation may have followed a somewhat different path in Macedonia (Andreou and Kotsakis 1987; Grammenos 1991; Pappa 2008; Kotsos 2014), but changes in portable material culture, particularly pottery, seem to parallel those in Thessaly.

Although each region has its idiosyncrasies, innovations in vessel technology and overall style show similar general trends from the earlier to the later phases of the Neolithic throughout northern Greece. The variety of

decorative techniques applied to pots is enriched during the MN, and particularly from the LN onwards, throughout the region under study and the stylistic variability of vessels suggests certain differences between MN and LN that may be of social significance (Perlès and Vitelli 1999). Although MN pottery in most parts of northern Greece is not well known, the available evidence suggests that technological and stylistic developments may have been shared throughout each region, with some differences in pottery style evident between regions (Urem-Kotsou et al. 2014a). At the beginning of the LN, an entirely new pottery style spread across northern Greece, with black burnished vessels standing as the hallmark of the new period. New elements in pottery technology, including firing and decorative techniques and changes in fabric recipes, along with entirely new shapes and decorative styles, seem to have appeared in a quite short period of time. Despite common inter-regional trends, regional stylistic differences are clearly evident, as in the MN, but LN stylistic regions seem to be smaller and more numerous (Perlès and Vitelli 1999, personal observations). Although the relationship between material culture and cultural identity is a complex issue, similarities in pottery style within a region may represent an attempt to create a common social space, while increased spatial variability between regions in ceramic styles may reflect more complex social conditions in the organisation of early LN communities as will be discussed below.

Changes in pottery technology and style through time were followed by changes in vessel use. As has been observed by Vitelli and others for southern Greece, there were significant changes in pottery use in the course of the Neolithic (Vitelli 1989; Perlès 2001). Recent investigations show that similar changes in vessel use took place also in Thessaly and Macedonia: in the Early Neolithic pottery was used merely for food consumption, during the MN pottery began to be used also for cooking of food and occasionally for long-term storage, but it was not until the LN that the everyday use of pottery became well established. Apart from serving and the consumption of food and drink, pottery in the LN was regularly used for cooking and long-term storage (Björk 1995; Yiouni 1996; Urem-Kotsou et al. 2014a; 2014b; Papadakou et al. *in press*).

Old and New Traditions: MN and LN Pottery Production and Consumption

These widespread and striking changes in pottery technology and style in northern Greece raise questions as to why and how they appeared around

5400/5300 BC, and how they were accepted and incorporated into local traditions. To investigate these issues, the new pottery tradition will be compared with that which preceded it. In particular, the generation of these innovations will be examined through a study of the technology and manufacturing process for ceramics during the MN and early LN in Macedonia, taking account of available evidence on the circulation of vessels during these periods. Information on pottery technology comes from the study of vessel fabric,² and surface treatment, including decoration and firing techniques. From anthropological and ethnographical research it is well known that the social conditions under which potters learn and exercise their craft are of crucial importance for the choices made in the manufacturing process (Gosselain 2011). Potters' choices may be also affected by the requirements of the users of vessels and the purpose for which the vessels are manufactured. The latter may have been of some importance to Neolithic potters in northern Greece since, as mentioned above, vessel use changed significantly during the periods discussed in this chapter. It is of crucial importance, therefore, to relate the technology used in vessel manufacture to the vessel consumption. As will be briefly discussed below, the MN and LN ceramics exhibit significant differences in various aspects of their technology, but considerable similarities concerning the consumption of vessels, since in both periods pottery was used for mundane practices albeit not with the same frequency.³

MN vessels were fired in oxidising conditions which resulted in more or less lighter colours, depending on the clay composition. Several fabric types were usually used in each settlement. The majority of vessels were locally produced and only a small number of them – normally tableware – were exchanged (Urem-Kotsou and Dimitriadis 2004; Saridaki et al. 2014). As mentioned above, during this period the uses of vessels changed, to encompass long-term storage and cooking in addition to the consumption of food. Although there is some relationship between pottery technology and use, it seems that changes in vessel use did not affect all aspects of their manufacture equally. On the one hand, choice of clay was not particularly related to vessel use: tableware tended to be of fine or medium fine fabric, but storage and cooking pots were often of the same fabric. On the other hand, surface treatment including decoration seemingly was related to vessel use. Thus,

² Pottery fabric is approached macroscopically by examining freshly broken sherd sections and microscopically through petrographic thin section analysis.

³ In the MN a very limited number of vessels were used for cooking, while the use of pottery for long-term storage has been testified only in few MN settlements so far. In the early LN (LN I) pottery has been widely used for cooking and long-term storage.

slip was usually applied only to tableware which also comprised the most elaborate vessels in the pottery assemblage. Three decorative techniques were in use: painting, impressing and addition of clay in the form of various pellets, ribbons and barbotine. Painting was the predominant technique and mainly applied to tableware, while the other two were usually far less frequent and were not closely related to a particular use-category.

From the beginning of the LN considerable changes are observed both in pottery technology and in overall style. Apart from vessel morphology and decoration, most characteristic innovations are related to manufacturing techniques. In particular, more complex techniques of the firing vessels were applied. In addition to the oxidising conditions characteristic of the previous period, reduction techniques were now widely used, giving vessels a grey or black colour. Both firing in a reducing atmosphere and smudging have been proposed for the production of black burnished and black topped vessels (Kaiser 1984, 249–54; Kalogirou 1994, 86–9; Gardner 2003), while different techniques seem to have been applied in the firing of grey-on-grey pottery (Vitelli 1994). Strikingly, the new firing techniques were applied mainly to tableware. Dark LN tablewares stand in sharp contrast to their light-coloured MN counterparts. LN potters throughout northern Greece appear to be familiar with the new firing techniques. Petrographic thin section analysis shows that the majority of black burnished and black topped vessels were locally produced (Dimitriadis 2002; Urem-Kotsou and Dimitriadis 2002; 2004). In addition, several new decorative techniques were applied, mainly to tableware, which further increased the complexity of LN pottery style. Channelled and rippled decoration, pattern burnishing, incisions with or without infilling, and a variety of impressed and plastic motifs are some of the innovations seen. Painting, the most frequent decorative technique applied to earlier Neolithic pottery, is now enriched with a greater variety of painting materials, with some changes in the combination of colours.

Although innovations are encountered in all vessel use categories they are not evenly distributed, with the majority occurring in vessels for the serving and consumption of food and drink. Tableware continues to comprise the most elaborate vessels in the ceramic assemblage, as in the preceding MN period, but LN vessels for consumption of food and drink seem to be more standardised in terms of technology than their MN predecessors, since the firing techniques and basic concept of paste recipe are shared across the regions. Conversely, they display greater diversity and complexity in decoration than their MN counterparts. More than one decorative technique is often encountered on a single vessel, while significant diversity in motifs

is observed between settlements. Unfortunately, there are still not enough data for a more analytical study of stylistic differences within settlements or between settlements within a region. Recent study of pottery from early LN Makriyalos, however, suggests that there may have been some variability in the distribution of decoration even within a single settlement (Urem-Kotsou 2006, 177–80).

Ongoing study of pottery from several MN sites in the region suggests that new elements in pottery production were not introduced at once, as a package, at the beginning of the LN period. Firing in reducing conditions, the hallmark of LN innovation, seems to have appeared already in an advanced stage of the MN. Vessels with typical MN shapes, admittedly few in number, already occur in grey or black colour from the late MN in Macedonia (Fotiadis et al. 2000; Urem-Kotsou and Dimitriadis 2004, 219, 239; Urem-Kotsou et al. 2014b). These vessels were apparently sometimes produced by potters with limited experience in the application of the new firing techniques, as MN vessels with uneven dark colour suggest. Strikingly, the first MN pottery fired with reduction techniques belongs to tableware and includes both bowls and jugs, as also later in the LN.

The majority of LN pottery in Macedonia was locally produced and the number of vessels that circulated was quite low as petrographic thin section analysis suggests (Urem-Kotsou and Dimitriadis 2004, 219, 239; Saridaki et al. 2014; Urem-Kotsou et al. 2014 a and b); as in the MN, the exchanged vessels belong to tableware. Apart from firing and decorative techniques, innovations appear also in vessel fabric. Recent study of pottery from several LN settlements in central Macedonia indicates that vessel use, for the first time, influenced potters' choices of raw material for their manufacture. In contrast to the MN, different paste recipes, in terms not only of the amount but also the kind of inclusions, were often applied to vessels of different use. Thus, cooking pots usually have a distinct fabric (in both quantitative and qualitative terms) from storage vessels and tableware. Although found in medium fine fabric, LN cooking pots usually belong to coarse ware. Tableware is usually of fine fabric, as in the previous period, but in contrast to MN tableware the fabric differs in composition from that of vessels used for other purposes (e.g. cooking and long-term storage). While each settlement (or group of neighbouring settlements) had its own way of doing things, a certain degree of standardisation is observed in all regions of northern Greece in the relationship between vessel technology and use. This holds particularly for tableware.

To sum up, of the innovations in pottery technology characteristic of the early LN in Macedonia, some were introduced already in the late MN,

but the majority first occurred during the initial stages of the LN. What seem to have changed in a short period of time are the association between paste recipe and vessel use, decorative techniques, decorative motifs and vessel shapes. Most of the innovations were applied to tableware, which also appears to have been the only category of vessel that circulated in both periods. Vessels moved, in both the MN and the LN, in small numbers and on a regional level, and were rarely exchanged between regions. Evidence for pottery production and circulation, however, is still quite limited from Macedonia, but is more abundant from Thessaly.

Recent studies of Neolithic ceramic production and consumption in Thessaly show that the circulation of pottery, although limited throughout the Neolithic, may have created complex networks at least in some regions (Pentedeke 2009; Pentedeke and Dimoula 2009). During the MN and LN periods several pottery wares were exchanged in Thessaly, but the mode and scale of exchange are different for each ware. In both periods the exchanged vessels belong to tableware, as was the case in Macedonia. By the beginning of the LN, however, the mobility of pottery in Thessaly seems to have increased, while the exchange network became more complex (Pentedeke 2009). Certain wares, like grey-on-grey, seem to have been produced in a particular area and probably at a single settlement, despite their widespread distribution throughout Thessaly (Pentedeke 2011).⁴ Other characteristic LN wares, like black burnished vessels, were locally produced in all regions of Thessaly, even in settlements where their occurrence is low. Although each settlement produced its own black burnished pots, these vessels also exhibit some mobility, but of small scale and more localised than grey-on-grey ware. Despite the fact that black burnished pottery was produced by many potters throughout Thessaly these vessels show common technological characteristics implying widely shared knowledge. They display some variability in fabric, which is probably related to some extent to local geology, but other aspects of their manufacture are common (Pentedeke 2009). The production and circulation of characteristic LN wares in Thessaly show a complex network which may be characterised as tripartite in terms of scale and the degree to which settlements participated in it. Thus, some settlements were mainly providers, others were providers and recipients, and some participated in the exchange network mainly as recipients (Pentedeke 2009). Certainly, some settlements were more actively involved in the network than others, creating nodes in the LN landscape.

⁴ A limited amount of grey-on-grey ware has been found in Macedonia, as well.

Trends in pottery technology and overall style, similar to those encountered in northern Greece, can also be detected in the Balkan interior. Although details of LN vessel production in this area are still quite scarce (Kaiser 1984), some conclusions may be drawn from the vessels' colour and decoration. Thus, the widespread occurrence of black or dark burnished tableware, and similar techniques applied in their decoration, points to shared knowledge and ideas in the production of LN pottery throughout this vast area.

The majority of MN and LN pottery was produced locally and only small numbers of vessels circulated, in most cases over quite restricted distances. This begs the question of how new pottery technology and style spread in a relatively short period of time across this vast area, from Thessaly to the Danube. To examine this issue further, mobility of other forms of material culture will be discussed briefly.

Mobility of Other Forms of Material Culture

Evidence of production and circulation is available for several other categories of material culture such as chipped, polished and ground stone tools, marble vessels, and stone and marine shell ornaments. Investigations show differentiation in the organisation of production and distribution of each particular category, indicating diverse and well-differentiated forms of networks of exchange.

During the LN, a significant increase in marine shell ornaments (i.e. *Spondylus gaederopus* and *Glycymeris* sp.) is attested in settlements throughout northern Greece and the Balkan interior. Their production has been recognised on several sites in Thessaly and Macedonia. Not surprisingly, the majority of the 'production centres' of marine shell ornaments are located in the coastal areas like Makriyalos in central Macedonia (Pappa and Veropoulidou 2011) or Dimini in Thessaly (Tsuneki 1989). Some, however, are situated at some distance from the coast such as Sitagroi, which is 25–30 km inland (Nikolaïdou 2010). Both long- and short-distance networks have been proposed for the distribution of the finished products in northern Greece (Kyparissi-Apostolika 2001; 2011). It has also been proposed that particular settlements were engaged in the production and distribution of marine shell ornaments, while other sites played a role in their redistribution (Karali 2004).

Spondylus shell ornaments were also popular during the Neolithic, particularly the LN, in the Balkans and central Europe and several possible

‘trade-routes’ have been suggested for marine shell ornaments found in the Balkan interior. These ornaments have proved to be of Aegean origin (Shackleton and Renfrew 1970; but see also Douka 2011). Finished products of Aegean marine shells could have reached settlements in the Balkan interior via the Axios/Vardar and southern Morava rivers or through the Dardanelles-Marmara and the Bosphorus. The latter path was most probably used for marine shell ornaments found in Bulgaria and Romania from where they could have reached the Danube region (Kyparissi-Apostolika 2011). The origin of at least some such ornaments in the Balkan interior and western provinces of northern Greece could alternatively have been the eastern Adriatic coast (Dimitrijević and Tripković 2006; Ifantidis 2011; but see Bajnóczi et al. 2013). Marine shell ornaments thus suggest complex exchange networks during the LN with various scales of networking in different directions. “Enchained exchange of shell ornaments, either through long-distance movement of special individuals or through a series of local inter-community exchanges” has been proposed by Chapman et al. (2011).

Diverse exchange networks are further supported by the evidence for movement of ‘exotic’ lithic objects including ornaments, vessels, chipped and to lesser extent ground and polished stone tools. The production of chipped-stone tools in northern Greece during the LN shows a rather complex picture since different systems may have been active in different provinces, while the distance that various products travelled varied considerably (Perlès 1992). A large proportion of chipped stone tools was manufactured locally, by locals, but some tools of high-quality flint were probably produced by itinerant specialists, others by exchange as finished products, while raw materials also travelled at various scales and directions (Perlès 1992; Dimitriadis and Skourtopoulou 2003; Tringham 2003; Skourtopoulou 2004). Obsidian chipped stone tools connect northern Greek provinces with Melos, while others made of high-quality materials were procured from networks of regional and inter-regional scale. The distribution of obsidian points to exchange through middlemen (Perlès 1992). There may be considerable differences in stone procurement strategies between sites within a single area, and between regions in northern Greece, while the degree to which Neolithic communities relied on local or non-local sources also varied (Dimitriadis and Skourtopoulou 2003; Tringham 2003; Tsoraki 2011a; 2011b).

The distances that various goods travelled and the scale of the exchange network for stone tools may be illustrated by the distribution of obsidian chipped stone tools. Most of the obsidian found in Macedonia is of Melian origin, examples of which have been found as far away as Neolithic Passo

di Corvo in the southern Italian Tavoliere (Perlès 1992). Macedonia also received some obsidian from other sources. A small number of obsidian tools of Carpathian origin have been found at Neolithic Mandalo (central Macedonia) and Dispilio (western Macedonia), while at Sitagroi (eastern Macedonia) an example from Cappadocia (Turkey) has been identified along with Melian obsidian (Kilikoglou et al. 1996; Tringham 2003; Milić 2016). Cappadocian obsidian testifies to relations between northern Greece and Anatolia, while Carpathian obsidian links northern Greece with the Vinča culture in the central Balkans (Tripković and Milić 2008) and, together with honey flint and *Spondylus* ornaments, indicates a complex network with goods and people travelling in various directions: both from south to the north, from east to the west and vice versa.

In addition to Melian obsidian, stone ornaments and marble vessels linked Macedonia with the Cyclades. Stone vessels found at the LN Limenaria settlement on Thasos in eastern Macedonia were made from Cycladic marble, from Naxos, Paros and probably Keros (Maniatis et al. 2009). The occurrence of Cycladic marble objects on Thasos is doubly interesting given that this island is itself rich in marble. The distance that Cycladic goods travelled in northern Greece is highlighted by marble rings found at Neolithic Dispilio in the mountainous interior of western Macedonia, far from the north Aegean coast (Ifantidis 2008; Ifantidis and Papageorgiou 2011).

The production and distribution patterns of stone tools, ornaments and vases thus show that northern Greece was connected with the Balkan interior, Cycladic islands, Anatolia and probably Adriatic coast through complex exchange systems, both as provider and recipient of a variety of goods. Various networks coexisted and certain differences between regions seem to have existed. Furthermore, exchange networks and modes of exchange vary with the category of goods. As we have seen with the production and circulation of pottery in Thessaly, marine shell ornaments and other materials, all settlements within a single region did not have the same role in exchange networks. Some settlements were important centres of production, distribution and redistribution, others played a more modest role at an inter-communal level, while some settlements seem to be less actively involved in regional networks.

Discussion

From the available evidence for MN and LN pottery production and consumption in northern Greece, many of the innovations that characterise

the early LN pottery tradition seem to have appeared in a relatively short period of time, at the beginning of the LN. Not all innovations occurred 'at once', as the new firing techniques applied already in the late MN indicate. Available evidence shows that MN potters who used the new firing techniques were familiar with local pottery traditions. Uneven colouring encountered on the early vessels fired with reduction techniques points to potters with limited expertise in the use of the new firing techniques. This suggests, at least in some cases, transmission of ideas to local potters rather than direct application of know-how by expert non-local potters. Judging from the experimental work on reduction firing techniques reported by Vitelli (1994), a certain level of know-how is necessary, but it seems that it could be achieved by experimentation and careful observation.⁵ It should be stressed that there must have been some technological differences regarding the reduction firing techniques between MN and LN. Apart from the uneven colouring frequently encountered on the MN dark ware, the surface of these vessels is often dull, while their LN counterparts display black shiny surfaces suggesting modifications in technology of dark wares through time. Furthermore, MN settlements in which the use of the new firing techniques is recorded, such as Dispilio, Apsalos and Stavroupoli, are located in different and distant areas of Macedonia, suggesting that the know-how might have been developed locally in different regions (Figure 3.1). The widespread and contemporary appearance of new firing techniques prior to the LN is also reported for settlements in some regions of the Balkan interior (Babić and Tomović 1996, 146–8). Significantly, MN vessels fired with reduction techniques were limited in number in both the Balkan interior and northern Greece, indicating that changes took place in contemporary communities across a vast geographical area, giving the phenomenon a 'global' character.

The relationship between the spatial distribution of material culture and cultural boundaries is complex, as anthropologists and archaeologists well know (e.g. Hodder 1982; Roberts and Vander Linden 2011). According to anthropological research, technical procedures are likely to alter under many conditions (Gosselain 2011). There are examples of techniques at various steps in the pottery manufacturing process changing during a potter's lifetime. Equally, some potters do not significantly change their way

⁵ In 2002 and 2003 a team from Paliambela excavation project, including Iannis Stangidis, the local potter from the village of Paliambela, carried out experimental work on reduction firing techniques. The application of smudging technique resulted often in pottery of uneven dull colour, similar to that of the MN dark ware.

of manufacturing vessels. Apart from methodological difficulties in correlating material culture with people, their identities and territories, the evidence for production and consumption of Neolithic pottery in most regions of Macedonia is still quite limited. Therefore, it is difficult at this stage of research to assess any contribution of non-local potters to the development of the new pottery tradition.

The circulation of vessels, albeit few in number, between settlements in northern Greece points to some movement of people carrying finished vessels between communities. It should be stressed that the majority of vessels did not travel a great distance, but were exchanged between settlements within a region or between neighbouring regions. The small number of non-local vessels and the limited distance between producers and consumers do not support the movement of itinerant potters across northern Greece, but rather point to exchange through middlemen and/or other kind of social networking. Residential movement of potters from one village to another, for reasons such as marriage or the avoidance of conflict, would certainly facilitate the dispersal of innovations within and between regions. Some variability in the formation and dissemination of knowledge in the early LN could be observed at least in Thessaly. As we have seen there is a greater variety in reduction firing techniques applied in the early LN. Different techniques must have been used in firing grey-on-grey and black burnished wares including the black topped ones. The know-how of firing black burnished wares seems to be widely shared, since these vessels were produced locally, have travelled short distances, but occurred all over northern Greece including Thessaly. Such a pattern might be related not only to the circulation of the pots, admittedly small in number, but also to the mobility of potters between communities within the regions. On the contrary, grey-on-grey ware was produced in a specific area (possibly in a single settlement) and travelled over long distances, although the distribution of these vessels was restricted to particular regions of Thessaly and Macedonia. The latter case points to greater control over the dissemination of knowledge.

Regional differences in pottery morphology and decoration point to increased cultural complexity in the early LN, but also to the application of local knowledge in manufacturing pots. Although genetic research has recently been cited in support of some human population movement in the later 6th millennium BC between the northern Aegean and Balkan interior ([Budja 2011](#), 41–2), it is clear that the exchange of goods played an active, perhaps dominant, role in the dissemination of knowledge and ideas.

It is of crucial importance that innovations in pottery occurred primarily in tableware in both the MN and LN periods. The application of a greater variety of firing and decorative techniques, the introduction of new shapes and radical changes in decorative motifs eventually changed entirely the style of tableware in the early LN. This suggests that innovations were related to the practices of consumption of food and drink, and it is probably not without significance that exchange of vessels in both periods was almost entirely restricted to tableware. It follows that the consumption of food and drink played a significant role not only in the generation and appropriation of the new pottery tradition but also in the changing social reality of Neolithic communities in northern Greece. It is commonly accepted that tableware is associated with the consumption and display of food and drink, thus tacitly recognising the social role of vessel style in acts of commensality. In the context of conspicuous consumption, the stylistic composition of an assemblage, and particularly of vessels for the consumption of food and drink, may be closely related to the social relationships between the participants. Increased variability in the morphology and overall style of early LN tableware thus implies greater elaboration in the social context of food consumption in this period than previously.

Changes in food consumption practices in the early LN are further supported by evidence that cuisine was enriched with a greater variety of cooking techniques used in the preparation of food, as reflected in the morphology and the size of early LN cooking pots.⁶ In the MN the variability in shape and size of cooking pots was extremely limited, implying a restricted variety of cooked food, at least in its form of preparation. The commonest MN dishes consisted of boiled food. LN cuisine, from a very early stage, was enriched by baked food and a greater variety of dishes, as indicated by a significantly greater variety of shapes and sizes of cooking pots.

Increased variety and elaboration of LN vessels for the consumption of food and drinks combined with a greater variety of dishes must have given added complexity to the act of consumption in the public arena. Further support for this may be found in the role of drinking in the context of public consumption in the early LN, indicated by pottery and archaeobotanical evidence (Pappa et al. 2004; Urem-Kotsou and Kotsakis 2007; in press; Valamoti et al. 2007).

Nevertheless, social competition expressed in the context of consumption of food occurred already in the advanced MN, as at late MN Sesklo

⁶ It is assumed that the shape and the size of cooking pots are related to cooking techniques, and therefore to the variety of dishes (Urem-Kotsou 2011).

in Thessaly. Here, the unequal distribution of fine decorated tableware between two different parts of the settlement (the 'Acropolis' and 'Polis') is interpreted as an indication of social asymmetry among the inhabitants expressed in public consumption practices (Kotsakis 2006). The example of Sesklo thus suggests that pottery and food consumption played an active role in social negotiations during the MN in Thessaly, providing the first indications of social complexity in the period that precedes the beginning of the LN. The social and economic significance of emerging households units must have played a dynamic role in the formation of social complexity in this period (Halstead 1999; Kotsakis 1999). In this respect, it is surely not coincidental that during the MN pottery began to be used for long-term storage. The appearance of large storage vessels points to hoarding, which would certainly give support to the emergence of the household.

Conclusions

Judging from the evidence discussed above, competition between individuals and groups expressed in the context of conspicuous consumption had a dynamic role in the formation of the new early LN pottery tradition. Early LN food consumption practices were enriched with a greater variety of dishes and the increased stylistic variability of tableware which points to an active role for food and pottery in social negotiations. This must have been one, if not the main, force for the generation and incorporation of the innovations in ceramic technology that appeared in the late MN and particularly in the early LN. Increased spatial variability in ceramic style during the initial phase of the LN, with smaller and more numerous stylistic regions, points to the formation of a more complex social landscape in the early LN in comparison with the previous MN period. Diverse exchange networks for a variety of goods, including pottery, and movement of people on various scales and in various directions facilitated the rapid spread of the new pottery tradition. Movement of potters, though on a rather narrow scale, seems to play an active role in dissemination of the knowledge as the black burnished wares suggest. The contrasting roles of individual settlements in production and exchange created a variety of nodes, differentiating communities on both a regional and an inter-regional level, enhancing the complexity of social networks in the early LN.

4 | Mobility and Early Bronze Age Southern Aegean Metal Production

MYRTO GEORGAKOPOULOU

Abstract

Mobility of people and materials was an inherent part of EBA Aegean metal production, with different patterns of spatial organisation attested. Within this context, similarities and differences in smelting technology are considered with reference to furnace design and possible interpretations on the patterns observed are offered.

Introduction

Metal production in the southern Aegean dates back at least to the Final Neolithic (Coleman 1977, 3–4). Present evidence, however, suggests that during the ensuing Early Bronze Age (EBA: c.3rd millennium BC), production of copper, lead and silver is attested in the Aegean on a large scale – in the context of this period – for the first time, supplying the metal for the majority of artefacts consumed in the region (Gale and Stos-Gale 2002; Stos-Gale and Gale 2003). Interestingly, for copper at least, this local production largely ceases in the following Bronze Age periods, a phenomenon supported both through lead isotope analysis and through archaeometallurgical fieldwork. This paucity of copper production is presently attributed to the limited scale of relevant southern Aegean, particularly Cycladic, mineralisations and their possible exhaustion at the end of the 3rd millennium BC, coupled with availability of metal from elsewhere (Bassiakos and Tselios 2012).

Academic interest in EBA Aegean metal production has largely shifted in the last fifteen years from provenance-oriented studies, with the widespread application of lead isotope analysis in this region during the 1980s and 1990s (see overviews and references in Gale and Stos-Gale 2002;

I am thankful to Evangelia Kiriati and Carl Knappett for their invitation to participate in this workshop and volume, which helped me formulate some of the ideas discussed in this chapter. I owe special gratitude to Dr Yiannis Bassiakos for introducing me to Cycladic archaeometallurgy and encouraging my work in this field ever since. An earlier draft was significantly improved through comments and corrections by Evangelia Kiriati and two anonymous reviewers.

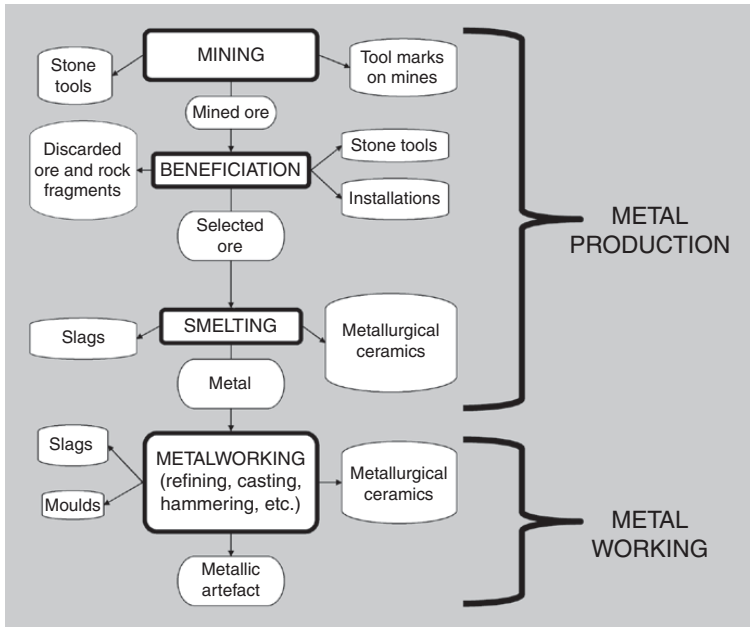


Figure 4.1 Simplified diagram showing basic steps involved in the production of metals and associated archaeological remains (designed by the author).

Stos-Gale and Gale 2003), to a surge of small-scale, site or region-specific archaeometallurgical studies (see examples in Betancourt 2006a; Day and Doonan 2007; Georgakopoulou et al. 2011; Papadopoulou 2011). The aim of the latter is to understand the nature and technology of metallurgical activities undertaken in a particular context.

The present chapter relies on the data available so far to examine, first, how mobility is manifested within the first stages of metal production. Second, it considers technological variability and homogeneity in metal production sites, concentrating primarily on furnace shape and operation. Through this analysis the chapter explores how mobile the technology of smelting was in the context of EBA Aegean metal production and considers what the emerging patterns potentially show about interaction and knowledge transfer among the people involved in these activities.

Metal Production and Metalworking

Production of a metallic artefact involves a series of processes from mining of the ore to the final shaping of the artefact. The simplified diagram in

Figure 4.1 presents the main steps of the whole process, common to all metals produced in prehistory from their respective ores (i.e. excluding gold or other native metals). Processes specific to certain metals, such as cupellation or smithing, are not included in this generic diagram. These can be divided into two groups: the first involves production of the raw metal and the second its working, with various steps included in the latter such as melting, refining, hot and cold-working. When comparing the two, various differences emerge with important implications:

- *Extent of transformation of starting materials:* Looking at the pyrotechnological stages within them, the process of smelting involves a dramatic physical transformation of matter, starting with what in many cases is a colourful stone (e.g. the green copper ore malachite) and ending with a drastically different material, reddish, shiny, and ductile copper metal. In melting, on the contrary, solid metal is liquefied and re-emerges as metallic matter again upon cooling, only in a different form.
- *Locality associations of the starting materials:* Another difference relates to locality associations of the starting materials in each case. The stages outlined in Figure 4.1 are inversely bound by geographical limitations. Mining, by definition, has to take place at the sources, with the remaining stages showing less and less attachment to the original source. Final shaping of the artefact can of course be completely detached from the location of its parent ore, particularly as many cycles of recycling may intervene.
- *Variation in the properties of the starting materials:* In smelting, the nature of the starting materials can differ significantly. Taking copper as an example, whether produced in the Aegean, Jordan, Cyprus, or the Alps, the properties of the metal used during the metalworking stages will be largely the same, assuming of course it is unalloyed. The miner on the other hand is not only confronted with a very different setting (Hardesty 2003), but also, depending on the geology of the particular area, has to deal with secondary green and blue ores or the golden sulphide chalcopyrite that not only look very different, but subsequently require different processing in order to produce the same copper metal. This ore may in turn be found in a siliceous matrix, ferrous or non-ferrous-rich, or an entirely different calcareous matrix all reacting differently in the furnace. Furthermore, the nature of the fuel as well as the clays used for furnaces and the other necessary ceramics need to be taken into account, although these may vary within both metal production and metalworking processes.
- *Visibility of technological choices:* While production of raw metal, from mining to smelting, is, to a large extent, bound by the geological and

geographical environment, within every stage of the production sequence there is room for choice. The archaeometallurgical record portrays numerous examples of how people did things differently (Childs and Killick 1993; Craddock 2001; Ottaway 2001). Here is, however, another distinction between the metal production and metalworking stages. Choices made in the latter will, to some extent at least, be seen and felt by the consumer, whether in the shape of the artefact or differences in physical properties induced by alloying or different metalworking treatments. On the contrary, neither the consumer, nor even the metalworker, have any way of knowing, unless they were present themselves during production, whether the raw metal used was made from an oxidic or sulphidic ore, whether a flux was used during smelting, or whether arsenic was added during or after smelting. These choices, situated within the metal production stages, are invisible in the final artefact, and therefore in principle unknown to the people not present during smelting (Gosselain 2000).

Some of the points raised here apply to some degree to ceramics and glass, the other two main pyrotechnological products of antiquity. In the case of ceramics, choices made in the early stages of production before shaping can often be reconstructed archaeologically through the study of the ceramic fabric on the products themselves (e.g. Kiriatzi 2003; Kiriatzi et al. 2011). With metals, although these choices are practically invisible in the final product, the ample archaeometallurgical debris or features left behind by each of the metal production stages provide a wealth of relevant information (see Figure 4.1).

The distinctions highlighted above justify the choice of the author to explore some of the issues raised in this volume focusing specifically on the primary metal production stages, from mining to production of raw metal. The chapter provides a first, preliminary approach to the relationship between mobility and metallurgy, while it is acknowledged that a fuller discussion of this subject should develop to include the entire production sequence and subsequent consumption patterns.

EBA Southern Aegean Metal Production: An Inherently Mobile *Chaîne Opératoire*

Distribution of Ore Sources Exploited in the EBA Southern Aegean

There are several copper and lead-silver ore sources in the south-central Aegean, but those of southeastern Attica and the western Cycladic islands

presently appear to have been more prominent in terms of EBA exploitation (Gale and Stos-Gale 2002). Their importance stems, on the one hand, from indirect evidence, that is the attribution of provenance of numerous metallic artefacts of this period to sources in this region through lead isotope analysis (Gale and Stos-Gale 2002; Stos-Gale and Gale 2003 and references within), and, on the other hand, from direct evidence provided by several local mining and smelting sites that will be discussed further below.

Southeastern Attica hosts the large multi-metallic ore deposit of Lavrion, which is proposed by lead isotope analysis to be a source for lead, silver and copper in this period (Spitaels 1984; Gale and Stos-Gale 2002; Gale et al. 2008). Unfortunately, mainly due to later large-scale exploitation in the Classical and particularly the early modern periods (Conophagos 1980; Kakavogiannis 2005), very little direct evidence for prehistoric exploitation survives (Spitaels 1984; Mountjoy 1995) and no smelting sites are known so far. Although the importance of Lavrion as a source for silver in the EBA is acknowledged from a wealth of other finds in the broader region (Kakavogianni et al. 2006; 2008), the evidence for copper production is presently less clear.

In the Cyclades, however, the picture is different to Lavrion and far more complicated. The islands are known for their abundance of small-scale, dispersed mineralisations that are usually of no modern economic significance, at least not for non-ferrous metals (Gale and Stos-Gale 2008; Bassiakos and Tselios 2012 and references within). Some of the silver-rich lead deposits, such as Ayios Sostis on Siphnos (Wagner and Weisgeber 1985), were substantial and there is evidence that these were exploited also in later historic times. Conclusive evidence for 3rd-millennium BC mining for silver-rich lead ore has been identified at Ayios Sostis, and probably also other sites on Siphnos (Wagner and Weisgeber 1985). For other Cycladic islands with lead ore deposits there is presently no direct evidence that these were exploited in the EBA.

Copper minerals are also reported on a number of islands, usually as minor accessories to iron ore deposits (Gale and Stos-Gale 2008; Bassiakos and Tselios 2012 and references within). The presently attested scarcity of copper minerals in the Cyclades, however, is in stark contrast with the extensive evidence for local production of copper in this period. Ancient and possibly also modern, primarily iron, mining have undoubtedly contributed to this picture. Presently, the only evidence for copper mining known from the Cyclades comes from Kythnos at Cape Tzoulis, Aspra Kellia and Petra, with all three indicating open-air mining (Gale et al. 1985;

Hadjianastasiou and MacGillivray 1988; Hadjianastasiou 1998; Bassiakos and Philaniotou 2007).

Distribution of EBA Aegean Smelting Sites

Turning to smelting, at least thirteen sites with evidence for EBA copper smelting¹ and two with evidence for EBA lead smelting² have been identified so far in the southern Aegean (Figure 4.2),³ with the majority concentrated in the western Cyclades. A few of them have been excavated (Hadjianastasiou and MacGillivray 1988; Betancourt 2006a; Papadatos 2007; Papadopoulou 2011), to different degrees, while the remaining have been dated to the EBA by surface pottery and thermoluminescence dating of furnace fragments (Zacharias et al. 2006a; 2006b), and more rarely by radiocarbon (Stos-Gale 1989).

These sites differ significantly in terms of three parameters outlined below (see also Catapotis 2007).

Scale

By far the largest known copper slag heap in the area is that of Avessalos on Seriphos with estimates for 100,000 tons of slag present. Still, although there is evidence that part of this material is dated to the EBA, the majority appears to be later and hence an estimate of the EBA scale is not possible

¹ These are Raphina, Sideri, Paliopyrgos-Aspra Spitia, Pounta, Lefkes, Avessalos, Kephala (Seriphos), Phournoi, Skali (location nearby settlement of Akrotiraki on Siphnos, scale of map does not allow separate representation), Dhaskalio-Kavos, Chrysokamino and Kephala-Petras. Note that Kephala (Kea) is not included in this count, as it is of Final Neolithic date.

² Ayios Sostis and Kasela on Siphnos (as for Skali, the location of Kasela is near Akrotiraki settlement on Siphnos, not possible to depict separately due to scale of map).

³ There are some discrepancies with the recent synthesis of EBA copper smelting sites presented by Catapotis 2007. Only clearly identified sites, all visited by the author or published adequately are presented here. The copper slag scatter at A. Symeon on Kea cannot presently be dated (Caskey et al. 1988; Pelton et al. 2015). The location of Petalloura and Aerata are uncertain from the published reports and they may refer to the site of Skali (Siphnos) and the settlement of Plakalona (Seriphos) respectively. There is only a brief report of A. Ioannis Eleimon and A. Ioannis Theologos and no further study has been undertaken (Bassiakos and Philaniotou 2007, 36). The nature of the furnace identified at Kolonna on Aegina is unclear and no smelting slags have been identified so far (Gauss 2010, 741; Walter and Felten 1981, 23–8). Finally, the analyses of the few undated slags identified at Konakia on Keros were inconclusive as to whether these were related to copper or iron metallurgy (Bassiakos and Doumas 1998) and the latter is more likely based on recent results from material collected during intensive surface survey (Georgakopoulou in press b). For these reasons the above sites are not considered here, without suggesting that they are not in fact associated with EBA copper smelting, while the site of Skali on Siphnos has been identified since.

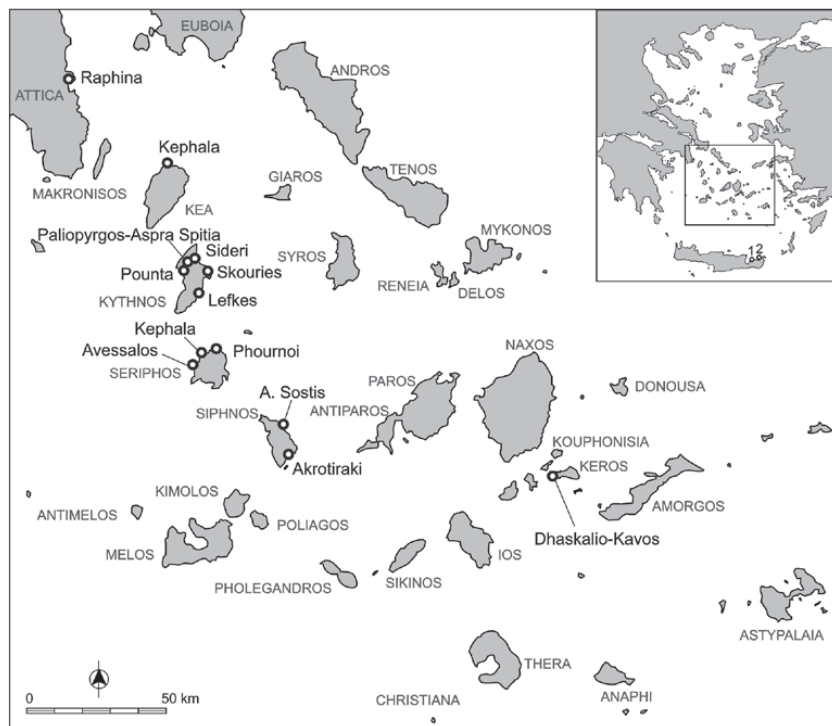


Figure 4.2 Map of the Cyclades and southeast Attica showing location of smelting sites discussed in the text. (In the smaller Aegean map are depicted the locations of Chrysokamino (1) and Kephala Petras (2) on Crete. The scale of the map does not allow separate representation of the copper smelting site of Skali and the lead smelting site of Kasela on Siphnos; both are represented by the immediately adjacent Akrotiraki settlement) (drawn by Nikos Valasiadis).

(Gale et al. 1985; Philaniotou et al. 2011). Beyond Avessalos, Skouries on Kythnos and Kephala on Seriphos stand out as the largest, with rough estimates suggesting several hundred tons of slag (Gale et al. 1985; Catapotis 2007; Philaniotou et al. 2011). Medium-sized slag heaps ranging one to a few tens of tons are Phournoi (Seriphos), Chrysokamino (Crete) and Ayios Sostis (Siphnos), while the remaining sites represented on Figure 4.2 would be estimated to less than one ton of slag,⁴ with only a few fragments found on some sites like Kephala Petras on Crete (Papadatos 2007; Catapotis et al. 2011) and Lefkes and Pounta on Kythnos (Bassiakos and Philaniotou 2007).

⁴ Note that there are no data on the size of the Raphina workshop.

Proximity of smelting to possible ore sources

Several different patterns are noted. The lead smelting site of Ayios Sostis on Siphnos is located beside the mine (Wagner and Weisgerber 1985). Similarly, mineralisations with convincing indications for exploitation were identified at Aspra Kellia and Petra at a short distance of less than 1 km from the copper smelting sites of Paliopyrgos-Aspra Spitia and Sideri on Kythnos (Bassiakos and Philaniotou 2007). For these three sites therefore it is clear that smelting was taking place in the immediate vicinity, almost adjacent to the mine. In the case of the two small smelting sites of Skali and Kasela on Siphnos, for copper and lead respectively, corresponding sources are not known in their immediate vicinity. At the opposite side of the Platy Gialos bay, however, at Aspros Pyrgos (c.2 km overland from Skali) (Wagner and Weisgerber 1985, 176–8; Gale and Stos-Gale 2008), there is a substantial copper mineralisation, while lead ores are abundantly present on Siphnos. Although there are presently no conclusive geochemical data, it is most likely that the sources of ores used at Skali and Kasela were local.

The large copper slag heap of Skouries is located relatively close to the mine of Cape Tzoulis (c.2 km south of Skouries), although doubts have been expressed as to whether this was a source for the Skouries smelting, given the steep climb required to access the smelting site from Tzoulis (Hadjianastasiou 1998). Another two small copper mineralisations were also identified near Skouries (at c.400 m and 700 m respectively) (Bassiakos and Philaniotou 2007, 25). Still, these occurrences appear presently surprisingly small when considered against the extent of this slag heap. The much broader lead isotope field occupied by the Skouries slags compared to the analysed Kythnian copper ores has led to suggestions that Skouries formed a central smelting site, where ores were brought from different islands (Stos-Gale 1998; 2000; Kayafa et al. 2000; Gale and Stos-Gale 2008). While there are reasons to contest the ability of the current lead isotope database to resolve such micro-provenance patterns (Georgakopoulou in press a), the scarcity of surrounding ores versus the quantity of the slags make this a very possible scenario. Indeed this kind of inter-island transfer is particularly plausible if we consider the proximity of the Cycladic islands between them (Figure 4.3)⁵ and the prominence of short-distance maritime travel in this period (Broodbank 2000; Chapter 2, this volume). A similar situation may be envisaged for the sites of Kephala and Phournoi on Seriphos.

⁵ Distances between neighbouring coasts of adjacent western Cycladic islands are c.15 km, easily within a day's reach with an Early Cycladic small canoe, and even more so with a Cycladic longboat (for relevant data see Broodbank 2000, 102).



Figure 4.3 View of Kythnos from the Kephala (Seriphos) slag heap (distance c.14 km) (author's photo).

The two sites, situated in the north/northwest schist units of the island, are at a significant distance from the island's rich secondary iron ores in the southwest marble zones (c.10 km direct distance overland from Phournoi to Mega Livadi mines and about the same for coastal maritime distance) and the magnetite deposits in the central part of the island at the contact of the schist and granodiorite units (c.5 km direct overland distance) (Georgakopoulou et al. 2011; Philaniotou et al. 2011). Both of these rich iron ore deposits, which were extensively mined in the modern period, bear copper minerals, today only in trace quantities. Although a faint copper mineralisation was recognised close to the Kephala slag heap, no indications of ore exploitation nor evidence for a substantial deposit were found. Unless large sources nearby remain unidentified, the most likely hypothesis is that ores were brought from sources elsewhere on Seriphos and beyond for smelting at Kephala and Phournoi. Thus, at least in the case of Kephala and Skouries, the original choice for using these locations for smelting may have been partly based on the presence of small-scale mineralisations, exhausted relatively quickly. Subsequently, however, it is likely that these sites were used for repeated smelting activities with ores brought in from different locations (see also below). In short, returning to the question of ore source and smelting proximity, in the case of the western Cycladic smelting sites in general and for Raphina on Attica, one can consider that, even if not adjacent to an ore source, they are located within

a broadly metal-rich zone, where short-distance (involving less than a day of one-way travel) ore transportation was taking place, although different patterns of spatial relations emerge.

Further smelting sites are, however, known outside this ‘metal-rich’ region, specifically at Chrysokamino and Kephala Petras on Crete and Kavos Promontory on Keros. Although Crete does have limited copper mineralisations, lead isotope analysis suggests that the ores smelted at Chrysokamino are not Cretan and were brought from outside the island, most probably from the western Cyclades (Stos-Gale and Gale 2006). It should be noted, however, that comparisons of slags and ores from Chrysokamino have suggested that the mixing of minerals was taking place, a practice that could have influenced attribution to specific sources (Bassiakos and Catapotis 2006, 346). Keros on the other hand is largely devoid of metal sources and the variable chemical composition of the slags again suggests importation of ores from outside the island (Georgakopoulou 2007a; in press c). For Chrysokamino and Keros, therefore, transportation of ores from longer distances was taking place (involving several days of one-way travel).

Proximity of smelting sites to contemporaneous settlements

Most of the smaller smelting sites are directly associated with a settlement. Skali and Kasela are located less than 500 m west and south of Akrotiraki respectively (Figure 4.4) (Papadopoulou 2011; 2013) and similarly close are Kavos Promontory to the settlement on Dhaskalio (Georgakopoulou 2007a; Brodie and Georgakopoulou 2015) and the Raphina workshop to the homonymous settlement excavated at the same time by Theocharis (Theocharis 1952, fig. 1). All of these sites appear to be directly associated with these settlements, located just outside of the habitation areas themselves, possibly to keep away the polluting metallurgical activities and/or to add a mystical element of isolation to the activities (Broodbank 2000, 294). In the case of Chrysokamino, there is no association with one specific large settlement, but there are habitation sites in the region, with a pattern of farmhouse clusters developing during EMIII. It is proposed that the inhabitants of such clusters may have been involved in the metallurgical activities of Chrysokamino (Betancourt 2006b; 2006c; Haggis 2006). Overall, it is becoming more evident that small-scale metal production in the vicinity of some of the EBA settlements was not uncommon (Georgakopoulou 2007b). The question now raised, however, is how widespread this phenomenon was and which types of settlements were involved in such activities in each case.



Figure 4.4 View of Akrotiraki (A), Skali (B), and Kasela (C) from opposite coast of Platy Gialos bay (Siphnos) (author's photo).

Contrary to the smaller smelting sites, none of the large smelting sites of the western Cyclades (Skouries on Kythnos; Kephala and Phournoi on Seriphos; Ayios Sostis on Siphnos) appear to be near a contemporaneous settlement and the same is true for the smaller sites of Paliopyrgos-Aspra Spitia, Sideri and Pounta on northern Kythnos.

Chronology of EBA Aegean Smelting Sites

The above discussion suggests significant variability in the spatial organisation of metal production activities in the southern Aegean that presently includes large and small smelting sites in isolation from settlements within the metal-rich zone (patterns A and B, [Table 4.1](#)); small-scale smelting within the same region associated with a specific settlement (pattern C, [Table 4.1](#)); and, on the other hand, at a distance from any ore sources, smelting in the proximity of a settlement or habitation clusters (pattern D, [Table 4.1](#)). These differences cannot be attributed to chronological development, but they can be shown to largely coexist. On the basis of recovered pottery, the Raphina workshop dates to the early EBII period (Korakou culture), while the nearby settlement shows both this phase and a subsequent late EBII Kastri/Lefkandi I phase ([Theocharis 1951; 1952](#); Kerasia Douni personal communication). A preliminary study of the pottery from Akrotiraki has suggested that it was occupied consecutively from the Final Neolithic to the late EBII Kastri phase. It cannot be presently concluded during which

Table 4.1. *Main smelting sites discussed in the text. Spatial patterns are grouped as follows (A: Large scale, in the ‘metal-rich’ area, in isolation from settlements; B: Small-scale, in the ‘metal-rich’ area, in isolation from settlements; C: Small-scale, in the ‘metal-rich’ area, in the vicinity of a settlement; D: Small/medium-scale away from ore sources, in the vicinity of a settlement; FN: Final Neolithic; EBA: Early Bronze Age; EM: Early Minoan)*

Region	Site	Metal	Date	Spatial pattern	Presence of perforated furnace frags
Attica	Raphina	Copper	EBII	C	Y?
Kea	Kephala	Copper	FN	C	Y?
Kythnos	Skouries	Copper	EBII only?	A	
	Pounta	Copper	EBA	B	
	Paliopyrgos-	Copper	EBA	B	Y
	Aspra Spitia				
	Sideri	Copper	EBA (and early MBA?)	B	Y
Seriphos	Lefkes	Copper	EBA	C?	
	Avessalos	Copper	EBA and later	A	Y
	Kephala	Copper	EBA	A	Y
Siphnos	Phournoi	Copper	EBA	A	
	A. Sostis	Lead	EBA	A	
	Skali	Copper	EBA	C	
	Kasela	Lead	EBA	C	Y
Keros	Dhaskalio-Kavos	Copper	EBII-III	D	
Crete	Chrysokamino	Copper	FN-EMIII (mainly EMIII?)	D	Y
	Kephala-Petras	Copper	FN-EMI	D	

phases within this long period metallurgy was practised, as the few sherds recovered from Skali and Kasela could only be characterised broadly as Early Cycladic (Papadopoulou 2011; Papadopoulou 2013). The settlement of Dhaskalio, off Keros, shows three chronological phases, with habitation starting from the beginning of the EBII (Renfrew et al. 2012). Again, it is unclear to which phase(s) the smelting workshop at Kavos Promontory corresponds (Brodie and Georgakoupoulou 2015), but remains associated with secondary metalworking activities were recovered from all three phases at

Dhaskalio (Georgakopoulou 2013). Finally, on Crete the few slags and ores from Kephala Petras are amongst the earliest evidence for metal production in the southern Aegean dating to between the FN-EMI periods (Papadatos 2007, 161–2). Pottery from all phases between FN-EMIII was recovered during excavations at Chrysokamino, with the middle phases, however, being significantly under-represented (Betancourt 2006a). The excavators proposed that the site was in operation at different times throughout the EBA, although it is acknowledged that the EMIII would have been the main phase of use (Muhly 2004), while the association of the few earlier pottery fragments recovered with metallurgy is challenged (Papadatos 2007, 155; Catapotis et al. 2011, 75).

In the case of the large smelting sites of Kythnos (Skouries) and Seriphos (Kephala, Phournoi and Avessalos) dating to particular phases is even more difficult, as none have been stratigraphically excavated. Furthermore, due to their size, it is very plausible that the sites were in use over several generations and across established chronological subdivisions. Sideri, Kephala and Phournoi have been dated with thermoluminescence dating of surface furnace fragments, with the resulting dates associated with large errors and covering almost the whole of the 3rd millennium BC (Zacharias 2006a; 2006b). Similarly for Skouries, although the diagnostic pottery recovered from the site was dated solely to the EBII (Hadjianastasiou and MacGillivray 1988), claims about this being a single period site cannot be confirmed in the absence of excavation.

Despite the enduring problems with the chronological resolution of most of the presently known EBA southern Aegean smelting sites, it is clear that the differences identified above in their spatial organisation cannot be attributed to chronological evolution as suggested for example in Chalcolithic-EBA Feinan where small-scale settlement-based smelting at a distance from mines is succeeded by large-scale smelting in the vicinity of the mines (Weisgerber 2003). During the middle of the 3rd millennium BC, in the EBII at least, several different spatial patterns appeared to coexist in the southern Aegean. Furthermore, the predominantly island environment of the region under consideration adds a different dimension to considerations of proximity, not encountered in other prehistoric metal-producing regions.

Mobility in EBA Aegean Metal Production

Although the majority of evidence for smelting is still largely concentrated in the western Cycladic islands, a picture that is unlikely to change in the

future, the new data highlight more complex spatial patterns than could be suspected prior to the last decade (Broodbank 2000, 292–7). Various forms of mobility, of people, raw materials, as well as final products, form an integral part of metal production activities. Mobility here is of a small to medium range, within a relatively confined region, but periodic and probably also seasonal (Broodbank 2000, 92–6) with a strong emphasis on maritime travel.

But who is moving and how? How widespread was involvement in metal production activities among the EBA communities of the southern Aegean and what scale of mobility did it involve (Chapter 1 this volume)? In his synthesis of the EBA Cyclades, Broodbank (2000, 292–8) suggested that metal procurement was based on a combination of direct access to ore mining and smelting by certain communities or groups, living within or outside the ‘metal-rich region’, together with indirect acquisition of ores, raw metal or ready-made artefacts by others. Broodbank acknowledged that there is no evidence for direct control of ore sources in the EBA Aegean, but suggested that control of metal production would have been indirect, based on resources (human and material) for maritime travel (as far as access to the western Cyclades is concerned) and metallurgical knowledge.

Significant new evidence has come forward in the last decade, but still the model appears to largely hold. The dispersed spatial distribution of smelting sites and the absence of settlements near the larger smelting sites or the prehistoric mines of the western Cyclades still suggests a lack of direct control of resources by any one settlement or social group within the metal production industry of the EBA Aegean. Metal production attached to specific settlements is now attested, but appears to have been generally of a small scale, as discussed above. New evidence has also been acquired from settlements within the metal-rich zone of the western Cyclades; Plakalona (Pantou *in press*) on Seriphos and Akrotiraki (Papadopoulou 2011; 2013) on Siphnos have both brought forward evidence for metallurgical activities, although unfortunately both are at an early stage of their study. Plakalona, specifically, is located within the rich secondary copper-bearing iron ore deposits of southwestern Seriphos, while the copper sources of Aspros Pyrgos are at a short distance from Akrotiraki. Although it is evident that these two settlements were involved in ore procurement and metal production activities, there is no reason to suggest that they had any limiting control over all or even their immediate resources (Broodbank 2000, 294). Even if they did control access to their immediate resources, however, a point that remains to be clarified, different set-ups may have

been at play for different sources, a diversity already argued in the case of the Yali and Melian obsidian exploitation (Georgiadis 2008). Furthermore, the significant distance of Plakalona and Akrotiraki from the large smelting sites of Seriphos (Kephala and Phournoi) and Siphnos (Ayios Sostis), respectively, makes it unlikely that their inhabitants controlled the corresponding metallurgical activities and it is even unclear whether they were involved in them at all.

The evidence with regards to mobility discussed so far concerns primarily copper. Lead/silver production appears presently to have been far more spatially restricted. Despite the wider distribution of lead ores in the Cyclades (Gale and Stos-Gale 1981), only the sources at Lavrion and Siphnos appear to have been exploited during the EBA, based on both lead isotope results and direct archaeometallurgical finds. Lead smelting sites are presently known only on Siphnos (Wagner and Weisgerber 1985; Papadopoulou 2011), while production should also have taken place in the Lavrion area, although relevant evidence is unsurprisingly lacking. The following step in the production of silver from argentiferous lead, that of cupellation, appears to have been more widely distributed, with litharge presently identified at several EBA settlements (Wilson 1999, 144–7; Georgakopoulou 2007a; Kakavogianni et al. 2008).

Technological Traditions in EBA Southern Aegean Smelting

Turning to the technological evidence for metal production in the EBA southern Aegean, the focus here is on smelting, as the data for mining are very limited. A couple of underlying common characteristics are noted. First, the majority, if not all, of the sites are located on north-facing wind-swept promontories, a choice which suggests the exploitation of the natural draughts for the operation of the furnaces. Second, the absence of visible charcoal remains is a notorious problem on these sites, impeding both the application of radiocarbon dating and archaeobotanical studies for the identification of the tree species used.

The evidence for the technology of smelting is, however, far from uniform. The most telling parameter concerns the shape and operation of the furnaces, which are the focus of this section. Furnace remains are usually identified on metallurgical sites as scattered slagged ceramic fragments, as furnaces were frequently destroyed after the smelt, leaving little behind on which to base a reconstruction. A particular idiosyncrasy of some EBA Aegean furnaces is the presence of multiple perforations on the

wall fragments (Table 4.1). Outside the Aegean, the only reports of similar perforated structures used in metallurgy come from entirely unconnected much later contexts in Thailand (Pryce et al. 2010)⁶ and the Bolivian Andes (Cohen et al. 2009). In the EBA Aegean clear use of furnaces with perforated walls is attested on the sites of Chrysokamino on Crete (Betancourt 2006a) and the two adjacent sites of Sideri and Paliopyrgos-Aspra Spitia on Kythnos (Bassiakos and Philaniotou 2007), where the vast majority of broken wall fragments bear evidence for multiple perforations. On Seriphos only a few of the ceramic wall fragments at Kephala (Philaniotou et al. 2011)⁷ had evidence for perforations, while the majority did not. Furthermore, only one perforation was usually seen per fragment, although a couple of fragments showed more. Interestingly, Theocharis (1952, 131) mentions the presence of perforations on the furnace walls from Raphina, although unfortunately the material is neither illustrated nor has it been studied since, so no further information is available. Perforations are also reported and illustrated on the few metallurgical ceramic finds from the Final Neolithic site of Kephala on Kea (Coleman 1977, 4). All of the above sites are associated with copper smelting. However, more recently perforated furnace wall fragments were also found at the lead smelting site of Kasela on Siphnos (Papadopoulou 2013). On much smaller scale, similarities in the concept are noted between these furnaces and the perforated clay utensil, known from Heraion on Samos, interpreted as a brazier, and proposed by Dumas as a possible Bunsen burner for working precious metals (Dumas 2011, 176–7 and figs 17.24, 17.25).

Despite their widespread distribution across the southern EBA Aegean, perforated furnaces are not present in all metallurgical sites of this period (Table 4.1). There is currently no evidence for their presence at Skouries on Kythnos or Phournoi on Seriphos, although both sites have numerous large furnace wall fragments visible on their surface. Similarly, they were not found at Dhaskalio Kavos on Keros, Ayios Sostis and Skali on Siphnos, Pounta and Lefkes on Kythos or among the few metallurgical finds of Kephala-Petras on Crete, although in all of the latter sites metallurgical ceramics tend to be very fragmented.

Even among the sites where these fragments are found, however, several differences are noted (Table 4.2). Unfortunately there are presently no

⁶ Note that recent reassessment of these structures suggests they were not associated with copper-smelting activities (Pryce et al. 2010, 249)

⁷ A similar pattern is seen also at the site of Avessalos on Seriphos, although dating of this site is complex and, for this, it is not included in this discussion.

Table 4.2 *Sites with perforated furnace fragments in the southern Aegean*

Site	Date	Smelted metal	Thickness of walls (cm)	Direction of holes on furnace fragments	Frequency of perforated furnace frags
Kephala (Kea)	FN	Copper	?	?	?
Raphina (Attica)	EBII	Copper	?	?	?
Paliopyrgos (Kythnos)	EBA	Copper	c. 4	At an angle downwards	All
Sideri (Kythnos)	EBA (and early MBA?)	Copper	c. 4	At an angle downwards	All
Kephala (Seriphos)	EBA	Copper	c. 4	At an angle downwards	Very few
Avessalos (Seriphos)	EBA (+later)	Copper	c. 4	At an angle downwards	Very few
Chrysokamino (Crete)	EMIII (+earlier?)	Copper	1-1.5	No slope	All
Akrotiraki (Siphnos)	EBII	Lead	c. 4	At an angle downwards	All

data for comparison from the earlier excavations of Kephala on Kea and Raphina on Attica, so these sites cannot be included in the following discussion. Among the remaining ones, as mentioned earlier, perforated furnace fragments represent only a minor percentage at Kephala and Avessalos on Seriphos and only one hole is usually retained on each fragment, making it unclear if these are actually fragments of truly perforated walls, like elsewhere, and if so how common their use was on this site. The finds from Kasela also stand out as they are the only ones associated with lead smelting, while surprisingly there were no indications for perforations on the metallurgical ceramic fragments from the nearby copper smelting site of Skali. It should be noted that both sites appear to be directly associated with the settlement of Akrotiraki, as both copper and lead slags were recovered during excavations on the settlement itself (Papadopoulou 2011; 2013).

Even looking at the clearest examples, however, those of Sideri and Paliopyrgos-Aspra Spitia on Kythnos and Chrysokamino on Crete, Bassiakos and Philaniotou (Bassiakos and Philaniotou 2007, table 2.11) have noted significant differences. On both, the perforated fragments are reconstructed as parts of chimneys placed on top of a small shallow

bowl. The perforations would allow air to come into the furnace promoting combustion. Differences are noted both in the thickness of the fragments, with the Chrysokamino ones being systematically significantly thinner, and in the direction of the holes, which in the Kythnian examples are directed downwards, while at Chrysokamino they are directed horizontally. The Kythnian examples show strong similarities with the other Cycladic examples, except that on Seriphos, as discussed before, multiple perforations on the same fragment are rare. A further telling difference, however, is the evidence for the use of bellows, which is, to date, unique to Chrysokamino. Admittedly this is the only site where large-scale excavation has been undertaken. On the other hand, both at Paliopyrgos-Aspra Spitia and at Akrotiraki on Siphnos, near Kasela, blowpipe tips have been found. On the basis of the above, a different operation of the perforated furnaces is suggested in the two cases. Aside from natural draught entering the furnace through the perforations, bellows would be used at Chrysokamino to provide more air at the base of the perforated shaft, while on the Kythnos and Siphnos examples air would be blown using blowing pipes through the holes into the furnace (Bassiakos and Philaniotou 2007, 46–7). The function of the holes in the two cases therefore would be somewhat different.

Lastly, there is some evidence in the Cyclades for completely different structures associated with smelting furnace use. First, at Skouries on Kythnos, where there are no perforated furnaces, round, stone-lined structures of c.4 m in diameter are still visible on the surface at the top of the slope occupied by the slag heap. These are thought to surround much smaller furnace bases, as one such base was identified within one of them during small-scale excavation (Hadjianastasiou and MacGillivray 1988). Catapotis proposes that such a setting may have been used to demarcate the work spaces of different groups operating in the same area (Catapotis 2007). Similar structures are not known in any of the other sites discussed here. Finally, at Kephala on Seriphos two furnaces carved on the schist bedrock were identified (Philaniotou et al. 2011, fig. 16.3); again similar structures are not presently known elsewhere in the Aegean.

The widespread distribution of perforated furnace fragments within the Aegean has led to its characterisation as an ‘Aegean metallurgical tradition’ (Pryce et al. 2007, 553–4). Even though the differences are acknowledged, the concept of perforations in smelting furnaces is thought to have been around for 1,000 years (Catapotis et al. 2008, 114). The present absence of similar contemporaneous evidence from elsewhere suggests that this is indeed an Aegean tradition, but what should

also be emphasised is that, as the above discussion demonstrates, there is by no means a single Aegean tradition in the shape and operation of smelting furnaces, and that in fact variability is more the norm than the exception. Equally interesting is of course the noted variability within this particular technological tradition.

The question is no doubt raised: were these different technologies synchronous or do they represent a technological development through time? There are no doubt serious limitations here, as lack of stratigraphy in excavated metallurgical sites, or in many cases absence of excavation altogether, prohibit a clear chronological resolution. Still, these different technologies can be shown to have largely coexisted. The earliest evidence for perforated metallurgical ceramics comes from few fragments from Final Neolithic Kephala on Kea (Coleman 1977, 3–4). Unfortunately, it is not clear, based on the published evidence, whether these are indeed parts of furnaces and further study of these fragments is necessary to address this question. If, however, this is indeed the earliest appearance of this practice, and given that the latest is associated with Chrysokamino, dated primarily, if not solely, to Early Minoan III, with sites such as Raphina and Akrotiraki dating in the middle of the EBA (Table 4.2), then indeed the concept of the perforated furnaces was present for the entire span of the 3rd millennium BC (Catapotis et al. 2008, 114), although practised somewhat differently in different sites, while on others within this period, altogether absent. Part of this diversity would be temporal, as is clear, for example, with the use of bellows at Chrysokamino dated to the end of the EBA (Early Minoan III–Middle Minoan IA) (Betancourt 2006a, 126), but overall it undoubtedly emerges that, at the peak of local Aegean metal production, around the middle of the EBA, different ways of smelting coexisted.

Discussion

On the basis of spatial evidence in the south-central Aegean and accepting a model of largely free access to resources as discussed above, several scenarios can be considered, with many or all of these possibly happening simultaneously. Communities from within the ‘metal-rich’ zones may have sent expeditions to mine ore from nearby sources, bringing these back to the settlements for smelting (e.g. Akrotiraki) or taking them to larger smelting sites used over generations (e.g. Skouries); this same ore collected from local communities may have been exchanged and shipped elsewhere for smelting; or groups may have travelled to the sources from outside this

‘metal-rich’ zone, prospecting for ore, mining and then smelting nearby or, alternatively, transporting this ore for smelting at home or exchanging it with other communities. In short, different groups, by no means all coming from the Cyclades (Broodbank 2000, 198), must be envisaged to move within the same physical landscape for the same purpose: to make metal. It is also clear that some of the craftspeople must have been directly involved in these travels as mining and smelting are seen to take place away from settlements. In this case stays in one particular place would have lasted a few days, while mining of ore and smelting were undertaken.

The technological evidence discussed above suggests that, although different groups were exploiting the same, relatively restricted physical landscape, different smelting practices were employed. On the other hand, the distribution of perforated furnace fragments suggests sharing and transmission of knowledge across sites, as well as differential adoption and appropriation of technological elements. Interestingly, the presence of perforated furnace fragments appears to geographically traverse our present understanding of Cycladic, Minoan and Helladic EBA, while the western Cycladic islands, presently by far the richest in archaeometallurgical evidence, host a variety of different smelting practices.

How is this picture to be explained? Are the different technological practices the result of adapting to different physical and environmental parameters at different sites? There is presently no such consistent evidence. Even though there are differences in the compositions of slags between sites,⁸ these do not correlate with the use of different types of furnaces, while the landscape features of most of these sites are remarkably similar, as discussed before. In fact, experimental reconstructions of perforated and non-perforated shaft furnaces have shown the advantages of the use of perforated furnaces, achieving higher temperatures as well as allowing for a more attractive visual display among the participants (Pryce et al. 2007). If the technology was around then, why was it not adopted on all sites? And, on the other hand, as smelting is a confined technological practice, known primarily to its practitioners and frequently undertaken in isolation from community members not involved (Childs and Killick 1993, 325), how was technological knowledge transmitted between those sites, where it appears to be shared to some extent? Was knowledge shared but in some cases different practices deliberately maintained to re-enforce group identities? Or

⁸ e.g. Chrysokamino slags (Bassiakos and Catapotis 2006) have significantly different composition to those from Kythnos (Bassiakos and Philaniotou 2007) and Seriphos (Georgakopoulou et al. 2011).

was it restricted, only witnessed by the practitioners themselves and only transferred through limited social avenues? What, in short, can we infer, about interaction between the different groups producing metal in this region?

To this end some thoughts with regards to the particularities of the processes discussed here can be offered at this stage. Groups reaching the sources from outside the 'metal-rich' zone would have to undertake significant prospection to find suitable ores and the other necessary raw materials (clays, charcoal, etc.) in a less familiar landscape. Compared to obsidian, the much more dispersed distribution of ore sources, particularly in the western Cyclades, certainly posed different challenges. As discussed at the start of this chapter, the nature of the raw materials may have differed from place to place. Indeed within the geology of Seriphos, for example, three distinct metal-bearing units are noted, composed primarily of hematite/limonite (southwest), magnetite (central) and mixed sulphidic deposits (north-central) (Marinos 1951). The repeated use of some sites for metal production, attested from their remarkably larger size (e.g. Skouries, Kephala, Phournoi), despite the absence of any clear large ore deposits in their environs, may have been brought about by initial landscape learning needs (Meltzer 2003, 237), possibly maintained through generations with ritual and memory-invoking connotations (Childs and Killick 1993, 328; Gosselain 2010, 196). Different types of furnace are not found mixed on the same site, with the possible exception of Kephala and Avessalos (the latter certainly largely composed also of later material), suggesting that the groups using a particular site maintained, to a large extent, the same technological tradition in furnace shape. Visits to the sources and the metal production sites would have been seasonal and relatively short (Broodbank 2000, 92–6). Although the same physical landscape may have been exploited by different groups, the conditions to acquire and adopt elements of new, different technologies, as is attested during longer modern mining rushes (Hardesty 2003), may not have been favourable.

Anthropological enquiry into the transmission of technological knowledge has highlighted the complexities underlying attempts to associate technological practice with social boundaries and social identities as well as the different dynamics pertaining in each stage of the production process (Stark 1998; Gosselain 2000; 2011). Ultimately, this chapter only attempted a preliminary discussion, focusing on a single technological trait of only one stage within the metallurgical *chaîne opératoire*. A fuller analysis, integrating all other evidence for smelting technology (nature of raw materials, slag composition, etc.), is necessary for these questions to be addressed, along

with incorporation of other material evidence from these sites, particularly the pottery. It should, however, be noted that slag compositions may show similarities or differences reflecting natural homogeneity or variation in raw materials, with differences in furnace design thus being more suggestive (Iles and Martínón-Torres 2009). Furthermore, smelting technology and spatial distribution need to be understood within the entire production sequence. Still, the present evidence highlights the potential of such an approach in the study of EBA southern Aegean metal production to inform on much more than the technology of the processes alone. Furthermore, the unique landscape of the region, largely composed of islands, combined with the scattered spatial distribution of ore sources and production sites, leave no doubt that seasonal mobility was a prerequisite among metal production craftspeople in the EBA southern Aegean.

5 | Stonemasons and Craft Mobility in the Bronze Age Eastern Mediterranean

ANDREW BEVAN AND ELIZABETH BLOXAM

Abstract

This chapter considers the evidence for craft mobility and cultural learning amongst stonemasons in the Bronze Age eastern Mediterranean. It draws on a range of cross-cultural comparative evidence, as well as placing particular emphasis on case studies from Egypt and the Aegean in the 3rd and 2nd millennium BC.

Introduction

Stone-working is one of the oldest craft traditions in human history and also one of the most closely studied. The latter interest is in part pragmatic, as stone survives extremely well in archaeological contexts, can sometimes be provenanced and demands subtractive working practices that often leave clear signatures of different technical traditions and choices. This chapter explores patterns of craft mobility and cultural learning associated with stone masonry in the Bronze Age eastern Mediterranean. In particular, we want to argue that three topics should loom larger, both empirically and theoretically, than they currently do in most current analyses of stone-based crafts. First, closer attention should be paid to the learning conditions that underpin stoneworkers' knowledge in different parts of the Bronze Age eastern Mediterranean. What are the wider implications of the apprenticeship modes by which stone-workers typically learn their craft and of stone-workers' often high levels of geographic mobility? How much do these features vary in different contexts, time periods or regions? Second, what particular social and

Part of this paper began as a talk by one of us at the "Mobile Technologies Across Dynamic Landscapes: Perspectives From Mediterranean Prehistory" workshop in Athens, and we would both like to thank the organisers Evangelia Kiriati and Carl Knappett for their organisation of that event and subsequent encouragement. We further acknowledge the research collaborations from which the Egyptian quarry material derives, and express particular thanks to Ian Shaw, Tom Heldal, Per Storemyr, Adel Kelany, Jim Harrell, Ashraf el-Senussi, Patrick Degryse, Norah Moloney and Richard Lee. We are also grateful to Tessa Dickinson and Todd Whitelaw for discussion of several topics touched on here.

political circumstances affect the way stone-working specialists are deployed across or beyond a given polity, and what consequences does this have for horizontal exchanges of craft knowledge? Third and related to the first two, we need to give more dedicated attention to the role of ‘bottleneck’ transmission episodes – for instance, when the number of people carrying a particular stone-working tradition is dramatically reduced for one reason or another – as this underlying demographic crunch is often accompanied by a physical diaspora and has important consequences for the disappearance or spread of crafting know-how.

We begin with a general discussion of the evidence for how stone-workers learn their craft, before briefly outlining the evidence for mobile stone-workers, both within and among different states, during the 3rd and 2nd millennia BC. Thereafter, discussion shifts to several case studies from Egypt and the Aegean that facilitate more detailed empirical study of these topics. For Egypt, there is a vast array of potentially relevant information, but we choose to focus on the challenges associated with stone procurement at source, and consider two different Egyptian quarries that emphasise craft mobility at diverse spatial scales and temporal rhythms. One of these involved massive project-driven procurement of a prestige stone destined for the Old Kingdom pyramid complexes, namely basalt from Widan el-Faras in the northern Faiyum. Transforming the quarry landscape over a period of 250 years between the third and fifth Dynasties of the Old Kingdom (c.2700–2460 BC), well-preserved archaeological traces through stone tools, object rough-outs, camps and standing infrastructure allow us to examine knowledge transfer from different organisational angles. For instance, from top-down deployment of specialists via royal state-run workshops, to an altogether more loosely based, bottom-up knowledge-sharing among kin-based groups of regional and local stonemasons. A second quarry landscape, for making grinding stones of silicified sandstone, on the West Bank of the Nile at Aswan, is less well known than the granite extraction site nearby on the east bank, but offers a useful vantage on the other end of the spatial spectrum, where everyday priorities were more mundane, but extremely consistent long-term use ensured a highly local, multi-generational tradition of craft learning that was largely distinct from state-organised and more thoroughly institutionalised enterprises.

Turning thereafter to the 2nd millennium BC Aegean, a whole spectrum of Minoan stone-working activity allows us to explore interesting similarities and contrasts with the Egyptian evidence. However, the focus in this case is less exclusively on comparing quarry crews and more on the world of elite artisans attached to Minoan and Mycenaean palace complexes. Particularly interesting are the clear mason’s marks on the sides of the finest architectural blocks found in Cretan palaces, and what this tells us about the organisation

and deployment of elite craftspeople in Minoan Crete and elsewhere. Many different interpretations have been offered for the significance of these marks, but we situate them very clearly within a wider cross-cultural pattern of specialist practice in ashlar masonry.¹ The Aegean case study emphasises the importance of a late 15th- and early 14th-century BC phase when the epicentre of elite stone-working traditions shifted from Crete to the Mycenaean mainland. Here, even in the absence of written records to this effect, we can make a reasonable case for the physical relocation of a limited number of Cretan craft specialists, followed by the reprioritisation of Aegean fine stone-working skills to transformed political agendas. A later if more hotly debated phase of possible technical exchange is potentially visible in some of the perceived Hittite influences on Mycenaean stone masonry, and it is worth comparing this episode to the earlier Minoan and Mycenaean example. However, without some sense of how individual stone-workers acquired, maintained and shared technical knowledge, such observations of technological diffusion would mean very little, and so it is first worth adopting a more cross-cultural perspective on how stone-working knowledge is often transmitted.

Contexts for Learning

The operational sequence behind stone-working, from extraction at source to final crafting, involves strategic choices on the part of the artisans involved – for example, anticipating the purpose of the end-user(s), the scale of the enterprise, the working affordances of the raw material, the availability of specific tools and the degree of acceptable risk to worker, tools and material. However, this extended creative process not only reflects conscious choice, but also less deliberate reproduction of one or more received technological traditions. Archaeologists have already devoted much attention to the issue of craft specialisation with useful results (e.g. [Brumfiel and Earle 1987](#); [Costin 1991](#); [Shaw 2012](#)). In what follows, however, we wish to emphasise three features that strongly affect technological traditions but that have as yet received only passing attention: (a) the need for long periods of adolescent apprenticeship, (b) the crucial role played by formal and informal ‘communities of practice’, and (c) the particular mobility often exhibited by stone-workers in comparison to other craft

¹ Ashlar refers to stone shaped into rectangular blocks with squared off edges and flat faces. It contrasts with building in more irregular blocks known as rubble masonry.

specialists. With respect to the first of these, it is worth stressing that, prior to the mass production of technical handbooks, specialised crafting skills were passed on via a time-consuming combination of personal experience and various kinds of face-to-face learning that typically took the form of apprenticeship (e.g. [Ericsson et al. 1993](#); [Gosselain 2000](#); [Epstein 2004](#); [Cianciolo et al. 2006](#)). For example, in medieval Europe, four to seven years of apprenticeship were usually deemed necessary for someone to become a master stonemason (see also [Johns 1904](#), 182; [Westermann 1914](#)), although different sub-skills (e.g. cutting stone, building walls, drilling things, carving decorative surfaces) might require different lengths of time, and there were always particular routes of sub-specialisation ([Knoop and Jones 1932](#); [Prak 2011](#), 398–403). Young children, almost always boys in documented cases of large-scale stone-working, were mentored by adult stone-working experts who (a) spelt out certain technical acts in an explicit way (i.e. via orally communicated recipes, familiar mantras, etc.) (b) encouraged them to physically imitate other technical gestures (that could not otherwise be explained verbally), and (c) offered them a context in which to develop further personal tacit knowledge by trial and error ([Shelby 1970](#); [Wagner and Sternberg 1985](#)).

However, while one-to-one master–apprentice relationships are very important for the above learning experience, a second point to emphasise is the role of wider communities of stone-working practice. Such communities can vary tremendously in terms of their size, physical location, make-up and degree of institutionalisation. In some instances, it is family and kin-based groups that play the crucial role, while in others the collective is a fraternity, building lodge and/or craft guild, with its own rules of conduct, closed membership and sometimes religious affiliations (e.g. [Prak 2011](#) and also [Grenne et al., 2008](#) regarding millstone quarrying in Norway). Quarries and building sites, marginal landscapes and urban metropolises all play a role as places where such corporate consciousness and knowledge-sharing develops. Sometimes the groups coalesce only temporarily but their sense of purpose is powerfully reinforced by the demands of a single mega-project, while in other situations the tempo of work is slower but more even, with considerable continuity over several generations or more. Regardless, stone-working collectives may not only have internal hierarchies but often fit into broader craft hierarchies as well. In the Bronze Age eastern Mediterranean, both archaeological and documentary evidence (see below) lead us to anticipate clear gradations between (a) highly specialised stone-workers with carefully monitored working conditions (e.g. attached to royal courts, upper elite estates or temple complexes), (b) apprentices on

a similar track but not yet given the same responsibilities, (c) all-purpose stonemasons who might be involved in a variety of different kinds of work and (d) larger local labour forces (see also [Knoop and Jones 1932](#), 355). We seek to identify some of these different cases and their impacts in the case studies below.

We will not address the flow of raw materials and finished stone products here in any detail but it is also worth stressing that, while most stone resources were deployed within a few kilometres of where they were extracted, others could travel hundreds of kilometres, and cross political borders, because of the functional, symbolic or aesthetic values ascribed to them (e.g. [Michel 1992](#); [Moorey 1994](#), 21–59; [Chanut 2000](#), 170–3; [Bevan 2007](#); [Marcus 2007](#), 141–50; [Bloxam and Heldal 2008](#), to name but a few Bronze Age examples). Moreover, both the people and equipment required for stone-working are necessarily mobile, over different spatial scales (e.g. among local communities, across large states or between them), at different temporal rhythms (daily, seasonal, project-driven) and for a variety of reasons. Hence, a third major feature of stone-working, in the light of cross-cultural evidence, is the fact that we should expect more persistent patterns of mobility and itinerant lifestyles than in many other crafts. For example, 19th-century English stonemasons travelled so frequently that unions of masons would underwrite each other's sustenance and lodging at local inns across the country ([Hobsbawn 1951](#); also [Prak 2011](#)). The tempo of long-running stone construction is also often very uneven, demanding very variable numbers of specialist stone-workers, journeyman assistants and young apprentices at different times. For example, in England during the summer months of 1253, 130 stonemasons and 220 assistants were employed at Westminster Abbey, but this number was halved by September of the same year as most of the assistants departed for other work (probably for the harvest; [Prak 2011](#), 386–7; see also Norwegian examples in [Storemyr and Heldal 2002](#); [Grenne et al. 2008](#)). Both a cause and effect of such uneven tempos was the need for geographically flexible working practices.

In the Bronze Age Mediterranean, our view of these patterns of mobility is dominated by documentary sources promulgated by palaces (and to a lesser extent temples) and it is perhaps unsurprising that the most obvious examples are therefore of specialists who travelled partially or wholly because they were made to do so. For example, at one extreme of scale are forced population displacements, such as those that saw numerous captured masons and ordinary labourers put to work on building projects in Achaemenid Persia ([Nylander 1972](#)) and for which there are also Bronze

Age hints (Zaccagnini 1983, 257). At a smaller scale, we can point to good Bronze Age documentary evidence for the gifting of individual specialists between royal courts. Physicians and entertainers were particularly sought after, but the need for a sculptor to make new statues is invoked in at least two separate letters, one from the Babylonian king to Hittite Anatolia, the other from the Ugaritan king to Egypt as a reason for sending an especially skilled artisan from one court to another (Zaccagnini 1983, 253; Lackenbacher 1995; Moorey 2001). Another tantalising 13th-century BC case may be the stone moulds for Hittite-style trapezoidal shields at Qantir-Piramesse which might simply imply local production of foreign objects, but could also reflect the redeployment of foreign specialists (Shaw 2012, 116–17; van Dijk 2000, 300). Such artisans were often kept at foreign courts for months or years longer than initially proposed, with many letters complaining (apparently in vain) about their delayed return.

Within states, there was also concentration of specialised labour in urban centres, particularly at the capital, and this sometimes left a comparative dearth of such knowledge in the provinces (Zaccagnini 1983, 248) and thereby provided a useful opportunity for royal patronage. For example, an Old Kingdom letter of protest from a quarry expedition commander of the ‘necropolis masons’ at Tura specifies the ‘royal residence’ as the source of payment, supplies and instructions (Eyre 1987, 15) and we come back to other clearly dendritic redeployments within Egypt and Minoan Crete further below.

Even so, we should be slightly cautious about treating these top-down claims to total control of specialist labour at face value. For example, the rhetoric of specialists-as-chattels, in the Amarna Letters and elsewhere, runs in clear parallel to a similar diplomatic choreography of merchants-as-ambassadors, kingdoms-as-personal estates and commerce-as-gifts (e.g. Bevan 2010a, 38–46). In many instances, there are strong hints that this was deliberately simplifying more complex realities and varying degrees of centralised power. In contrast, more voluntary mobility, both of the hyper-skilled and the ordinary stonemason, is harder to unpick in Bronze Age contexts. Some hints are offered by personal names attesting to father and son teams of Syrian craftsmen in Egypt and later Aramaic texts in the Wadi Hammamat greywacke quarries imply the presence of non-Egyptian stone-workers (Couyat and Montet 1912; Simpson 1959, 35–6; Moorey 2001, 9). Furthermore, both formal records and graffiti found along trade routes in the Eastern Desert and Lower Nubia refer to specialist prospectors and gemstone importers called the ‘Sementiou’ (Yoyotte 1975, 44–55). The idea of ‘travelling tinkers’ or nomadic family groups with craft skills has been

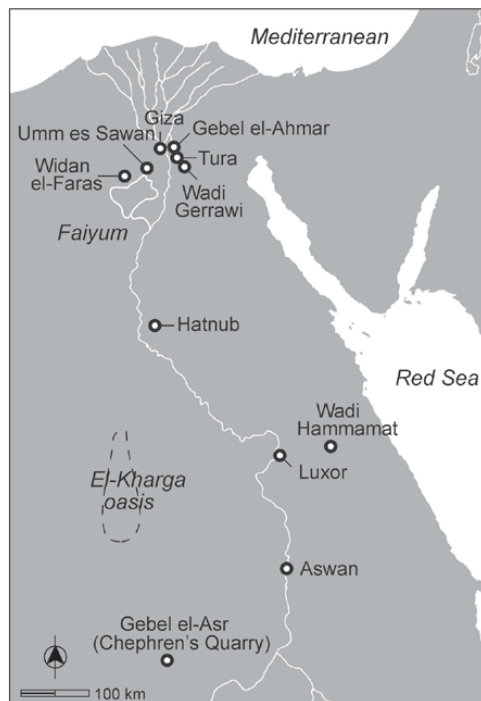


Figure 5.1 Map of Egypt showing the sites mentioned in the text (drawn by author).

one of many interpretations of a Middle Bronze Age tomb painting in Beni Hassan depicting a group of southern Levantine ‘Amu’ who are probably traversing a regular trade route connected with the extraction of galena and other resources in the Eastern Desert (Newberry 1893, 69, pls. xvii, xxviii, xxx, xxxi; Goedicke 1984; Kessler 1987; Kamrin 1999; Moorey 2001, 11; Bloxam 2006, 295–6). The simple conclusion to draw is that we always need to think of the elite specialists with reference to a wider, often quite varied pool of crafting knowledge and practice.

Egyptian Stone-Working: 3rd–2nd Millennium BC

In what follows, we begin some more empirically based discussion of the above issues by looking at stone-working at the source, via a comparative analysis of quarries that were at the epicentre of large-scale resource procurement in Egypt during the 3rd and 2nd millennia BC (Harrell and Brown 1994; Harrell and Bown 1995; Bloxam and Storemyr 2002; Bloxam et al. 2007; Shaw et al. 2010). Although the major focus will be on Widan el-Faras

(basalt) in the northern Faiyum and the Aswan West Bank (silicified sandstone) we also make mention of other important sources such as Gebel el-Asr (Chephren gneiss) in Lower Nubia (Figure 5.1). Basalt, silicified sandstone and Chephren gneiss were all highly sought-after hard stones used for ornamental objects (e.g. obelisks, statuary), building stone (ashlar blocks, other masonry) and certain utilitarian purposes (grinding stones, tools). They were also channelled to a range of depositional contexts locally, regionally and internationally. Because the sources of these stones span a wide geographical area, we have an opportunity to analyse contact at source between mobile stonemasons from a range of spatial scales and temporal rhythms.

The study of quarries has moved in particularly fruitful directions in recent years, and now addresses not only the technological specifics of resource extraction but also a wider social and organisational context (Bradley and Edmonds 1993; Cooney 1998; Bloxam et al. 2009; Shaw et al. 2010; Bloxam 2011a; Hamilton et al. 2011; Dickinson 2014). First, it is worth emphasising that quarries are rarely singular archaeological ‘sites’ but rather comprise whole ‘landscapes’, transformed by exploitative practices that ebb and flow in relation to how sought-after a particular stone’s properties were at a given time (see for instance Cooney 1999; Bloxam et al. 2007; Haldal 2009). These properties may relate to functional uses of the stone for cutting or grinding, aesthetic qualities such as colour and texture and/or symbolic associations with particular sources and religious ideologies. Some sources can also be important meeting places that draw in groups from a wide geographical area and are maintained over several generations. As Mark Edmonds (1999, 47–8) has pointed out for European Neolithic contexts, the maintenance and transmission of stone-working traditions is often mediated at the stone source through successive generations of local people, and hence by certain forms of unbroken cultural memory, including the multi-generational preservation of craft knowledge (for further enlightening Australian examples, see also Taçon 1991; McBryde 1997; Fullagar and Head 1999; Brumm 2010, 191–3).

Stone-worker mobility and knowledge exchange can be assessed through several types of quarry evidence: for instance, both changing extraction techniques and altered logistics of subsequent transport. The suite of stone tools found at quarries are particularly important portable objects to consider in this regard, as they can be brought in from often distant sources, often make themselves visible to the archaeologists as artefacts that are geologically incompatible with the local area, and thereby inform us about an organisational framework of links between stone-workers and certain strategic resources (for more discussion of stone tool circulation between

kin-groups see Bradley and Edmonds 1993, 96; Cooney 1998, 108–18; 1999, 49–51; Edmonds 1999, 47–8; Bradley 2000, 86–7; Boivin 2004, 10–16; Bloxam et al. 2014; Bloxam 2015). The construction of purpose-built roads and other logistical apparatus may also have encouraged interactions among otherwise distinct cohorts of specialists, for instance, between boatmen, road-builders and stonemasons. Marks made on quarried blocks by individuals or teams of stone-workers and control notes made by scribes illuminate how stone sometimes passed through several distinct groups on its way from quarry to construction site, thus creating other potential spheres of interaction (see Arnold 1990). In addition, it is worth considering the engravings on rocks near quarries that socialised these landscapes in important, long-term ways (Taçon 1991, 195; 1994; Bradley 2000, 38–9; Boivin 2004; Bloxam 2011a, 156–61), and might range from figurative imagery to specialist marks to narrative inscriptions. Although these rarely enlighten us directly about practice, the occurrence of names and titles in a quarrying context are useful indicators about evolving roles, hierarchies, kin-groups, project-driven expeditions and blends of local and regional religious practice, amongst other things. Turning to the Egyptian case-study quarries considered below, these have been chosen both because they offer examples of this full spectrum of possible evidence, and because they capture a range of scales of mobility and knowledge exchange, spanning: (1) localised deployments in quarries where long-term craft traditions in stone-working already exist; (2) the conditions arising from shorter term mega-projects.

Aswan West Bank

The Aswan and First Cataract region is perhaps most famous as a centre of granite quarrying in pharaonic and later periods, with major extraction sites located on east bank of the Nile. Less talked about are the silicified sandstone (sometimes called ‘quartzite’) quarries along the west bank at Aswan. This was one of two major Egyptian sources of silicified sandstone, with the other located at Gebel el-Ahmar and far less amenable to modern study as it lies within modern Cairo. Here we examine the extent to which changes in the consumption of ‘ornamental’ products (by which we mean objects such as obelisks and statuary, but not architecture or tools) at Aswan may have interacted with a pre-existing very long-term tradition of stone tool production in the area. Relatively good preservation of the quarry landscape has allowed us to trace these different types of exploitation along the Aswan West Bank and how they have changed over time (for more detailed

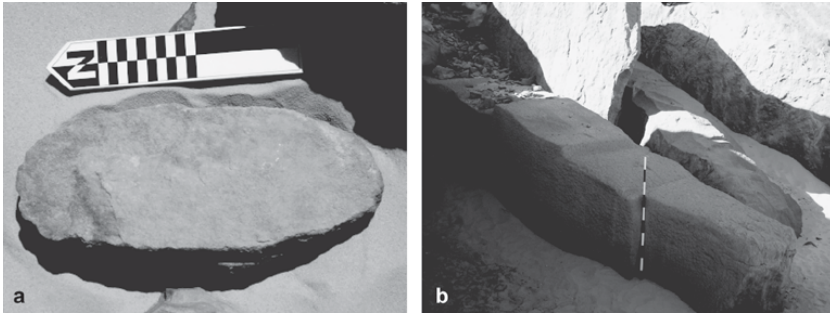


Figure 5.2 Aswan West Bank silicified sandstone quarries: (a) a typical oval grinding stone, and (b) truncated New Kingdom obelisk(?) still partially attached to bedrock (author's photo).

description, see [Bloxam et al. 2007](#)). The properties of silicified sandstone made it highly sought-after from a very early stage as a key material for tools and grinding stones ([Figure 5.2a](#)). The oldest phases of production, from the Lower Palaeolithic tool makers (300+kya) to Predynastic (late 4th millennium BC) grinding stone producers, are usually located around the bases of the *gebel* landforms where naturally loosened boulders could be found (see [Heldal and Storemyr 2007](#); [Heldal 2009](#), 136–42; for more detailed description).

In addition, from the Old Kingdom onwards, silicified sandstone was also quarried in a more formal way for large ornamental objects, even if most early traces have been obliterated by later workings. On an aesthetic level, the stone's glittering properties gave it symbolic value as 'the most solar of stones', leading to certain discrete episodes of large-scale exploitation for ornamental objects when royal religious and ideological change was linked with the solar cults ([Kozloff et al. 1992](#), 76, 110; [Quirke 2001](#), 76; [Bloxam et al. 2007](#), 38–9, 42–3). The New Kingdom ornamental quarries are perhaps the most prominent surviving examples of this, with unfinished objects such as truncated obelisks often remaining attached to bedrock in the quarry and dateable by associated ceramics and inscriptions ([Figure 5.2b](#); [Heldal and Storemyr 2007](#), 102–22; [Bloxam et al. 2007](#)).

The basic stone tools and methods used to split and shape already loose boulders into grinding stones at Aswan did not change significantly from the Late Palaeolithic into much later periods, with stone tools used to split and shape already loose boulders ([Heldal and Storemyr 2007](#), 86–7; [Bloxam 2011b](#), 47–8). These tools included cobbles of both silicified sandstone and igneous rocks, all locally sourced to the West Bank and roughly shaped into pounders ([Heldal 2009](#), 136–42). Fire-setting is a technology used to

extract larger blocks from the bedrock and, while it does occur in some grinding stone quarries, its use is far more extensive in all the New Kingdom ornamental quarries (Heldal et al. 2005; Heldal and Storemyr 2007, 102–16; Heldal 2009, 136–42). A further contrast is that prefabricated dolerite tools, with origins on the East Bank at Aswan and commonly found in the granite quarries there, are found almost exclusively in the ornamental quarry localities rather than those used for grinding stones. A further piece of evidence for new injections of specialist stone-crafting knowledge that was hitherto unknown on the Aswan West Bank is an obelisk top with finely carved relief and good parallels in the granite quarries on the East Bank.

So should we interpret these discrepancies and changes as the adaptation of local technologies to quarry new, larger objects, or is it more appropriate to think of the arrival of new stone-workers from elsewhere, bringing both new agendas and different skills? The only textual reference to regional deployment of specialists from elsewhere that might be connected with this period of ornamental quarrying is the stela of ‘Bak and Men’. Referring to them as ‘overseers of works’ and ‘chief of the sculptors of the Red Mountain’ (the latter thought to refer to the Gebel el-Ahmar silicified sandstone quarries near Cairo) they appear to have been tasked with overseeing the extraction and transport of monuments for Amenhotep III and Akhenaten from Aswan (Habachi 1965). However, any expectation that such imported specialisms would revolutionise existing work practices and technologies proves difficult to substantiate based on the archaeological data. For example, the semi-finishing of objects in the new ornamental quarries did not differ from that used for grinding stone production, with the only notable innovation in the former being the additional step of ‘channelling’ to extract obelisks (Heldal 2009, 148). Rather, the evidence suggests more straightforward adaptation, on a larger scale, of techniques that had already been known locally for many generations.

Given that obelisk quarrying involved fire-setting and the use of dolerite tools, a feature of granite quarrying on the East Bank (Heldal 2009, 146–8), one scenario to consider is that there was a far more local transfer of specialist stonemasons from the east to west bank, conceivably in the form of a short-term daily commute in which they brought their tools with them. These local transfers might well be considered as only minor forays that did not significantly undermine existing stone-working traditions, particularly since ornamental quarrying in the New Kingdom lasted less than 100 years. Grinding stone production during and after these episodes showed no significant change (Bloxam 2009, 172–4; Heldal 2009, 146).



Figure 5.3 Quarry roads: (a) at Aswan, and (b) at Widan el-Faras (author's photo).

Hence, it is tempting to suggest that what we are observing at Aswan are local stone-working sub-specialisms, rather than large-scale injection of external personnel from central royal workshops. Returning to 'Bak and Men', an alternative reading would be that they were redeployed from the

central administration in order to enhance transport logistics rather than to assist with physical stone-working. In line with this, it is notable that Aswan boasts perhaps the world's most extensive networks of quarry roads, associated with the transport of mainly ornamental products (Figure 5.3a; Bloxam et al. 2007, 151–62; Heldal 2009, 146–9). We would argue that imported specialist knowledge from elsewhere in the Egyptian state relates strongly to these technologies for road building and logistical organisation and it is in these contexts that we should situate any possibilities for horizontal transmission of technological know-how between local and non-local specialist groups.

Widan el-Faras

The quarry landscape at Widan el-Faras in the northern Faiyum also provides extremely impressive evidence for transport infrastructure, connected with episodic large-scale basalt quarrying during the 3rd millennium BC. Basalt began to be exploited in a substantial way for Old Kingdom temples and causeway pavings. Before this, the material was largely used for stone vessels and tools, but (a) the local evidence for early stone-working at Widan el-Faras itself is far less evident than at Aswan, and (b) many of the basalt stone vessels and tools may have been made from stones coming from other sources (e.g. Mallory-Greenough et al. 1999). In other words, the quarrying of ashlar blocks at Widan el-Faras entailed a more abrupt arrival of new production methods and logistical know-how than at Aswan. Indeed, these changes all happened over a relatively short timespan coinciding with the construction of Khufu's pyramid (see Bloxam and Heldal 2007 for discussion of the 'industrialisation' of the northern Faiyum). One of the results was the world's oldest paved road, constructed from local sandstone, limestone, fossilised wood and basalt and linking the Widan el-Faras basalt quarries to a quay 11 km away on the shore of Lake Moeris, from where the basalt blocks were then shipped out of the Faiyum and over 80 km down the Nile to the pyramid fields at Giza and Abu Sir (Figure 5.3b; Caton-Thompson and Gardner 1934, 136–7; Shafei 1960, 192–3; Arnold and Arnold 1979, 25; Harrell and Bown 1995; Bloxam and Storemyr 2002, 29–30).

These quarry roads also imposed structure on the communities of stone-working practice operating in the area. For example, the densest concentrations of dwellings and inscriptions are found in the immediate vicinity of quarry roads. At Widan el-Faras, the only known encampment is situated strategically at the entrance to Widan el-Faras with vantage points north into the quarries and south where the road heads towards Lake Moeris (Bloxam

and Storemyr 2002, 33–4). Similarly, at Gebel el-Asr in Lower Nubia, the transport route out of the quarries is where we find the only inscription relating to possible ‘overseers’ of craftsmen and also two distinct Old Kingdom camps (Shaw et al. 2010). Both camps command a clear vantage point along the transport route and reveal pottery assemblages dominated by basic cooking and storage vessels (Bloxam 2011c, 2–3).

The meeting of overland and water transport systems near Widan el-Faras also created important opportunities for interaction between those specialists who transported stone overland and those who operated boats. For example, while ashlar blocks usually left the quarries partially worked, at Widan el-Faras, some further shaping of blocks seems to have occurred at the road terminus at Lake Moeris, in order to further reduce transport weight (Bloxam and Storemyr 2002, 30–1). Further cooperation between different specialist groups is also likely to have occurred here over how best to handle and load large stone blocks. More generally, it is also worth invoking a later series of Middle Kingdom team marks (made by stonemasons) and control notes (made by scribes) on stone blocks for pyramid construction in the Faiyum at Lisht (for what follows, see Arnold 1990, 14–29). Here, a mixture of hieroglyphs and invented geometric characters (some of which also have Old Kingdom antecedents) were either chiselled onto stone or painted using ochre. Almost all of these marks are concerned with transport issues and patterned combinations of verb + locality + workmen in the inscriptions suggests that stone-working teams came from both local communities and elsewhere in Egypt.

The Widan el-Faras road is also a good example of converging kinds of craft knowledge (and people), in spite of the fact that the region does not exhibit the same obviously pre-existing local stone-working tradition as at Aswan. On the one hand, ingenious use is made of local construction materials, most likely borne of certain participants’ long familiarity with these resources. On the other, the input of centralised engineering skills is probably discernible in the fact that the road has a width conforming to the standard Egyptian measure of 4 cubits and possessed mortared foundations with parallels at the pyramid construction sites (Arnold 1991, 81–98; Lehner 1997, 203, 215–17). Indeed, the cross-fertilisation of new techniques, from pyramid-building to quarrying, may have been quite common, and is arguably also visible at the Wadi Gerrawi travertine quarries, where limestone masonry techniques first used for pyramids were also employed for building a dam (Petrie and Mackay 1915, 39–40; Murray 1947, 38).

However, despite these instances of technological cross-over from pyramid site to quarry, certain kinds of specialist practice remained exclusive to

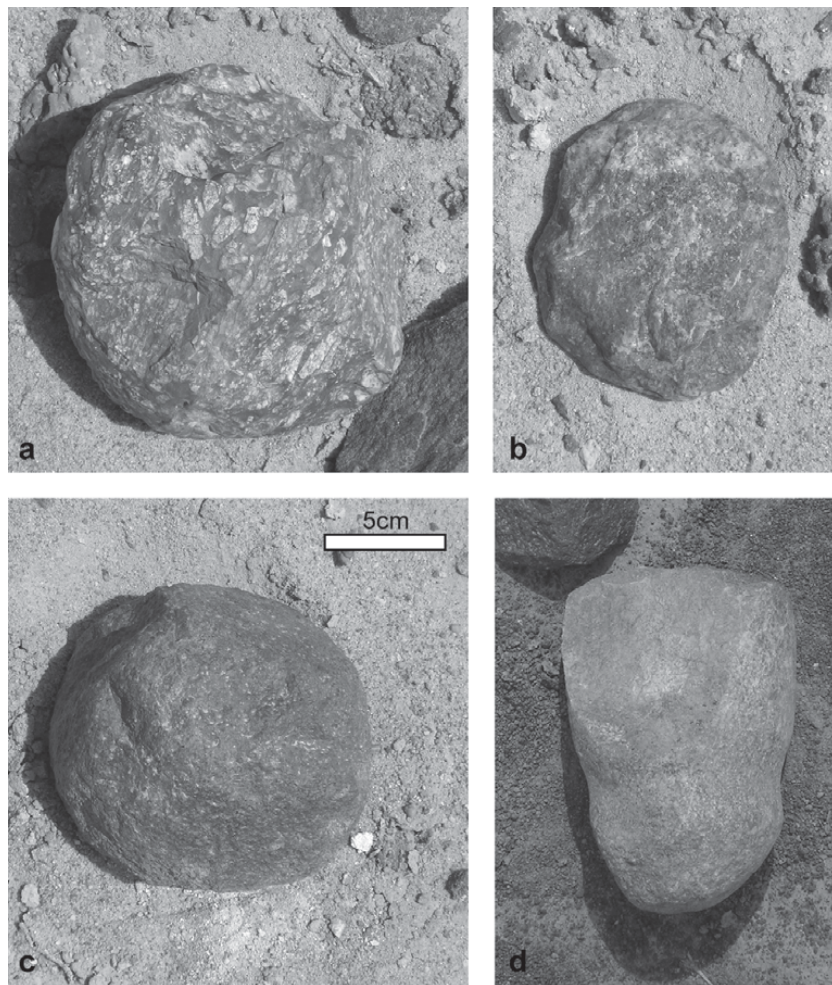


Figure 5.4 Non-local stone tools from northern Faiyum quarries: (a) in diorite (found at Umm es-Sawan), (b) Cephren gneiss (Umm es-Sawan), (c) granodiorite (Umm es-Sawan), and (d) gabbro (Widan el-Faras) (author's photos).

the former locations, and it is tempting to see this as an example of the limits applying to specialist knowledge transfer, at least in the Old Kingdom. For example, once the blocks from Widan el-Faras reached the Giza plateau pyramid complexes and mortuary temples, they seem to have been subject to further cutting-up with large saws (Petrie 1883, 174–5; Moores 1991). The Old Kingdom saw the first application anywhere in the world of large-scale sawing to hard rocks, and it is striking for our understanding of the organisation of stone specialists that this technique is not known at the quarries at this time. While this absence may conceivably just reflect the

different kinds of task necessary at extraction versus construction sites, it is tempting to instead see it as indicating that certain cutting-edge methods and tools were used only by those specialists who were closely connected to central royal workshops and who worked exclusively at construction sites near the capital.

A final important point to stress is that, although prestige products were primarily channelled to pyramid construction sites and workshops, some exotic stones also found their way into other quarries, usually as tools. In this regard, the northern Faiyum quarries reveal pounders and axes made of an exceptionally diverse range of non-local stones ([Figure 5.4a–d](#)): Chephren gneiss from Gebel el-Asr (over 800 km away), diorite from the Aswan region, gabbro and dolerite from other distant locales were all used to quarry basalt at Widan el-Faras ([Bloxam and Heldal 2007](#), 314). At the contemporary Umm es-Sawan gypsum quarries 20 km to the northeast of Widan el-Faras we see an equally high proportion of imported stone tools from the same distant sources ([Harrell 2002](#), 235; [Bloxam and Heldal 2007](#), 314; [Heldal et al. 2009](#), 60). One explanation for this is that the local geology in the region did not provide adequate resources to produce local stone tools and hence there was an unusual need to import these tools to northern Faiyum quarries. Another, which we favour slightly, is that these quarries were also unusually well-connected hubs for stone specialists, with a to and fro of personnel that was itself unusually intense compared to other quarries at this time.

Userkaf and Phyles

It is worth ending this section of Egyptian case studies by focusing on contemporary evidence for working practices at a construction site from a single reign rather than over the kinds of landscape palimpsest often visible at quarries. Out of a range of possibilities, the pyramid complex, sun temple and associated fixed equipment (sarcophagus, statuary, doors, etc.) of the pharaoh Userkaf (c.2460 BC) at Saqqara and Abusir provide a particularly useful vantage. Taken as a whole, these monuments encompass what we might construe as a full range of royal stone resources and major quarries in the Late Old Kingdom: basalt (Widan el-Faras), Chephren gneiss (Gebel el-Asr), pink granite (Aswan), greywacke (Wadi Hammamat), silicified sandstone (Gebel el-Ahmar and/or the Aswan West Bank), travertine (Hatnub and/or Wadi Gerrawi) and fine limestone (Tura). Four limestone tablets found at Userkaf's sun temple also provide one of our best sources of evidence for the structure of stone-working crews linked to a royal construction site (typically referred to by modern commentators via the Greek

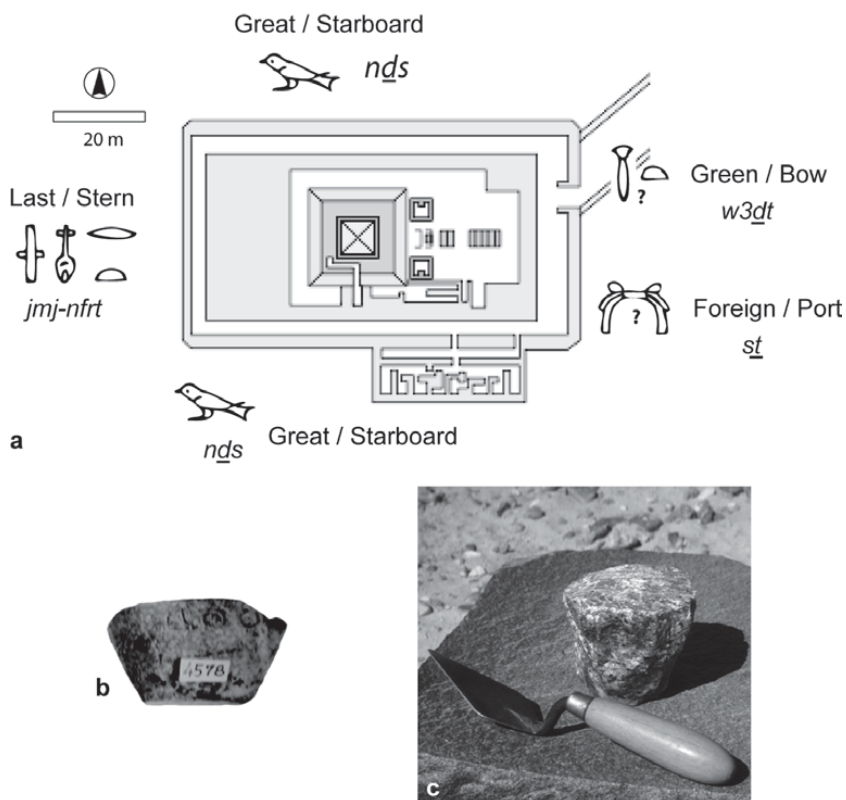


Figure 5.5 (a) Roth's (1991, fig. 7.4 with additions) tentative reconstruction of the spatial organisation of work by phyle groups at the Sun Temple, based on records preserved on four limestone tablets from the site; (b) a small cup, seemingly of Chephren gneiss, found on the Aegean island of Kythera (Coldstream and Huxley 1972, 266, pl. 86), but with an inscription identifying it as from Userkaf's sun temple, and (c) a small vessel pre-form from the Chephren gneiss quarries at Gebel el-Asr (author's photos).

gloss 'phyle': for what follows, see especially Roth 1991, 133–42; also Ricke 1965–9). The tablets confirm other evidence for the existence of five phyles of two divisions each, a structure which has close parallels in the Egyptian royal priesthood. The tablets also suggest that these crews probably served for one month and worked primarily during the two seasons after the inundation. The phyles also seem to have divided up their activities spatially, across different parts of the monument (Figure 5.5a). In this particular instance, at the construction site rather than the quarry, it seems likely that only one fairly large group of stone-workers was employed, such that the opportunities for learning were very likely to be within the group rather than due to the coming together of several different ones.

Late Bronze Age Aegean Stone-Working

An intriguing but attenuated link between the latter evidence from Userkaf's sun temple and the Aegean 2nd millennium case study that follows is provided by a tiny inscribed stone cup said to have been found in a tomb of probably later 2nd millennium BC date on the Greek island of Kythera ([Figure 5.5b](#); for these tombs see [Preston 2007](#)). Such objects are often found in 2nd millennium BC contexts abroad, and while they may very rarely have been local Cretan heirlooms curated from 3rd millennium exchanges, they are frequently likely to have been the proceeds of later 2nd millennium BC tomb-robbing in Egypt (e.g. [Phillips 1992](#)). On Crete especially, a case can be made from them being recognised as recycled antiquities but deployed as curated antiques alongside potential powerful claims by certain individuals or groups to lineage and long-term socio-political legitimacy ([Bevan 2007](#), 124–60). In any event, the Kytheran vessel appears to be made of Chephren gneiss (at least viewed through its case in the National Museum in Athens) and its rim bears an inscription identifying it as equipment from Userkaf's sun temple (indeed probably contemporary with the earlier stages of its construction: [Sethe 1917](#)). As we have seen, the phyle-based specialists were responsible for the sun temple's construction, and an inscribed chisel ([Rowe 1938](#), 391–3, pl. 57) may also place them at the Chephren gneiss quarries where vessel pre-forms of similar small size and conical shape to the Kytheran vessel have been found ([Figure 5.5c](#)). More precisely, the Kytheran example was a model beer bowl and part of a black and white stone pair commonly included in opening-of-the-mouth sets used in both royal jubilee and funerary cult of 5th–6th Dynasty rulers ([Bevan 2007](#), 72, [fig. 5.4c](#)). Overall, therefore, the combined example of the gneiss quarries, sun temple and beer bowl miniature evoke a particularly neat example of mobile artisans and mobile stone objects, spanning a thousand years, a thousand kilometres and a range of official and subversive forms of procurement and use.

Minoan Crete

Stone-working in the Aegean also offers a useful complement to the Egyptian case, not least because we can explore two successive and rather different deployments of stoneworkers and stoneworking skills, on Minoan Crete and thereafter on the Mycenaean mainland ([Figure 5.6](#)). On Crete we can see experimentation with stone vessels and visible elaborate stone architecture from pre-palatial times, but our focus here is on patterns



Figure 5.6 Map of the southern Aegean showing the sites mentioned in the text (drawn by author).

visible in the Neopalatial period (c.1700–1450 BC). Both local Cretan and imported stones were being used for portable objects such as stone vessels, tables and lamps at this time (Warren 1969; Bevan 2007, 119–33), while palace-style buildings were regularly constructed in fine ashlar masonry (in limestone, sandstone or gypsum), sometimes faced with gypsum panelling (Chlouveraki 2006).

Ashlar was only used for certain portions of certain buildings and rarely travelled far away from a location point of extraction. A key point to note is that much of the final dressing was often done in the quarry, with multiple ashlar blocks reassembled at the construction site in the same order as they were cut from the quarry. The effort and skill therefore goes in at the point of stone-cutting, while less skilled masons can handle the setting of blocks at the construction site. In contrast, when construction materials are irregular (e.g. the ‘Cyclopean’ masonry discussed below), the situation is typically reversed: less skilled masons can rough out the blocks at the quarry, but more experienced ones need to handle their selection and combination at the construction site. For example, in eastern Crete, the sandstone used for ashlar in certain important Neopalatial buildings (Malia, Gournia, Palaikastro, Zakros) came from a series of coastal quarries between 1 and 14 km distant from each site, and from which groups of cut blocks could

probably be transported by raft (Soles 1983; MacGillivray et al. 1984, 144–9). Given the narrow use of such ashlar in this region of Crete, and the relative quantities extracted compared to those consumed, it seems likely that the quarries were opened with a specific construction in mind so skilled masons might spend a one-off block of time at the quarry rather than live near it permanently.

Perhaps the most striking evidence for stone-worker mobility takes the form of mason's marks placed on these fine ashlar architectural blocks (Hood 1987; Chlouveraki 2002; Begg 2004a; 2004b). These usually take the form of small pictograms, with links to, but distinct from, actual Cretan scripts, and the largest concentration of marks is found at Knossos. If we restrict our attention to only the mason's marks of probable Neopalatial date, Knossos' dominance is further emphasised by the fact that smaller sites within, say, four hours' walk of Knossos are far more likely to have gypsum architectural elements, ashlar façades and mason's marks than those further afield. Considering this in its wider context, Neopalatial architecture is largely stone-built, albeit with further use of timber and mudbrick superstructures in many instances (Shaw 2009). Every town and village clearly had access to local or itinerant stonemasons with adequate skills, just as it often did to stone vessel-makers (who may sometimes have been one and the same), as well as potters and other artisans. In contrast, for those elite stone specialists involved in working (and marking) gypsum and ashlar, it is very tempting to see them as a carefully controlled resource, widely used for acts of patronage within the immediate hinterland of Knossos, but only in a very targeted, political way across the rest of the island. The 'gate/window' mark found in an ashlar quarry 5 km south of Palaikastro (Driessen 1984) and whose only close parallels are from 50+ similar signs at Knossos is, we would argue, a good sign of Knossian masons who had travelled to the far east of the island (Figure 5.7).

The meaning of the Neopalatial mason's marks have been the subject of considerable debate, with a range of practical and religious explanations having been offered. Certainly, some of the marks clearly carry Minoan religious connotations (e.g. the double-axe) and some are placed in visually prominent locations on the walls of symbolically charged parts of the palaces. However, we would argue that religious and ideological meanings of mason's marks often follow on from primary practical purposes, in part because wider craft institutions (e.g. guilds, fraternities etc.) with their own symbolic repertoire are often involved. Moreover, many, perhaps the majority, are found in places that would not have been visible on the final monument, suggesting that their role cannot primarily have been for display (Begg 2004a, 220).

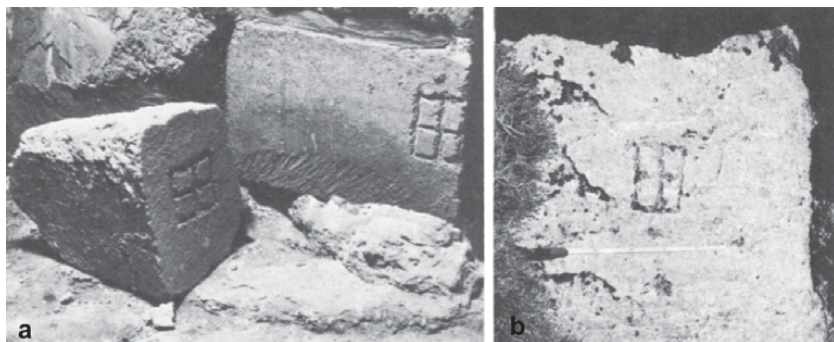


Figure 5.7 (a) ‘Gate/window’ marks on ashlar blocks from Knossos, and (b) a similar mark at a quarry near Palaikastro (reproduced from [Driessen 1984](#), fig. 13e–f).

We should also distinguish between these mason’s marks, and more complex commemorative inscriptions or simpler assembly marks for reassembling cut blocks ([de Vries 2009](#)). The latter for example tend to be more numerical in character (quantities of associated blocks, position in terms of vertical courses, etc.), have basic indicators for left/right, and/or lines to guide exact positioning. In contrast, mason’s marks often have more complex designs, but ones that also show similarities even in widely separated cultural contexts, as they act as mnemonics for individual workers or groups. More generally, mason’s marks are found primarily in western Old World stone masonry practice (to our knowledge) in situations that (a) almost exclusively involve finely finished blocks (ashlar), (b) where the pool of available masons becomes quite large and (c) often when remuneration is accorded by the quantity and quality of piece-work, rather than via regular pay ([Nylander 1974](#); [Alexander 2007](#); [Bachmann 2009](#); [Depauw 2009](#); [Fuchs 2009](#)). Of course, we should not push the cross-cultural perspectives too far. There remain some differences between the clear group- or team-marks visible in Egyptian (see [Arnold 1990](#); [Andrassy 2009](#)) and Minoan examples on the one hand, and the arguably more individualised marks of certain later periods, suggesting that a model of individual piece-work may not be wholly appropriate for the former. The association of the Minoan marks with small teams of skilled masons seems the most likely, and in some instances the association of certain marks with certain parts of the palace (e.g. the double-axe with the west wings), suggests possible forms of regularised (and potentially hierarchical) tasking for different teams, as also suggested above for Egyptian phyles.

These small teams of Cretan stone specialists were almost certainly attached to one or more Cretan Neopalatial palaces (potentially only Knossos) and

treated as valuable human commodities, rationed out in acts of patronage from the centre in contrast to the more widespread availability of ordinary masons. In this regard, the parallel situation for fresco painters is instructive. Here too, it seems as if almost every Cretan village could get occasional access to an artisan with sufficient skill to decorate walls or whole rooms, in monochrome or with simple designs (e.g. [Blakolmer 2000](#)), suggesting the permanent presence of a local specialist or more likely a lower cadre of itinerant painters and plasterers. In contrast, the distribution of paintings with bulls, griffins, processions and other elaborate designs, made in a wider variety of colours ([Bevan 2010b](#), 40–2, table 3) again maps out a tight hinterland around Knossos and almost certainly reflects a closed group of unusually skilled and resourced artisans deployed via acts of patronage. In the cases of both fancy wall painting and ashlar, there may also be some strong sumptuary laws at work (such that only very specific kinds of people, places and services were perceived as deserving of such patronage), but at a more practical level it almost certainly speaks to centralised control over the tasks taken on by the most skilled artisans.

Beyond Crete the situation seems slightly different: both the wall-painting styles and the mason's marks at Akrotiri, for example, exhibit overlaps with Crete but are nonetheless slightly different, suggesting a related but distinct group of specialists working here and perhaps occasionally on other islands (e.g. [Palyvou 2005](#), 120–1). Beyond this a third distinctive zone of mobility clearly existed, at least for the fresco-painters, as there are extremely good reasons for seeing direct transfers of wall-painting teams from Crete to various eastern Mediterranean centres, with court-to-court gifting appearing by far the most likely form of mobility (see [Brysbaert 2008](#); [Bevan 2010b](#)). We will return below to the question of whether this is also to some degree true of stonemasons.

Mycenaean Greece

Whatever the exact character of the transition of political power during the 15th century BC on Crete, there is clearly widespread destruction at Cretan palatial sites. At Knossos, which seems to avoid a full-scale destruction at this time, there is evidence of increasingly strong cultural (and for some commentators, political) influence from mainland Greece, and later on the same observation can be made for much of the rest of the island. Beyond this, 15th- and earlier 14th-century Knossos provides the most likely context for several narrow acts of technological transfer. We might envisage these as occurring alongside a sharp narrowing of the existing metropolitan elite,

administrative bureaucracy (these two potentially being distinct groups but more likely one and the same) and certain attached artisans. Likewise, over no more than a few generations, these groups were compelled to alter their working practices and interact more strongly with, or travel to, the palace centres on the mainland. For example, Driessen and Schoep (1999) argue persuasively that it is just in this episode at Knossos that Cretan Linear A was most likely adapted to write a narrow range of Mycenaean administrative documents in archaic Greek and disseminated to a wider group of Mycenaean palaces abroad. Likewise, the wide range of manufacturing options exhibited in the stone vessel industry in the Neopalatial period on Crete (especially in terms of drilling methods and shape variety) gives way in the 14th century BC to only one or two manufacturing methods. A much narrower range of shapes almost certainly reflects a much more circumscribed group of specialists, a limited range of operating conditions, as well as, most likely, the transfer of some of these individuals from Knossos to the mainland (Bevan 2007, 157–65, 188–9). While certain craft skills largely disappear from the Aegean in the century or two after the Late Minoan IB Cretan destructions (Rehak 1997), we can also point to a broadening of access to certain stone-working skills that probably reflects a physical diaspora of certain specialists from Crete into an increasingly multi-polar Aegean and an increasingly international eastern Mediterranean.²

The sequence of building phases from later 15th to 14th century at Pylos, however poorly preserved beneath the later 13th century (Late Helladic IIIB) palace,³ appear to be extremely Minoan in character and to change styles in step with those in Crete (Nelson 2001; 2006). The wider region of Messenia also exhibits the earliest tradition of tholos tombs with possible links to the Cretan funerary and architectural practice. Moreover, one block from the Pylos palace received a Cretan-style mason's mark (a double-axe) and two further masons' marks (a branch and a double-axe) have been found on a tholos tomb at Peristeria further north (Nelson 2001, 186 with further references). All of this is wholly out of character with the wider tradition of mainland stone-working at this time (see Darcque 2005) and implies stonemasons who had apprenticed over long periods in a fully

² Although we do not address the topic here, there are a range of plausible technical links between the Aegean, Cyprus and the northern Levant during this period, marked e.g. the spread of keel-vaulted tombs, and the 14th-century uptake of ashlar masonry and masons' marks on Cyprus (e.g. Philokyprou 2011).

³ Note in passing that there is brief mention of a 'wall maker' (*to-ko-do-mo*), who possibly worked in stone, in the Pylos Late Helladic IIIB archives as well as a possible foreman (Ventris and Chadwick 1973, 123, 179–82; Shaw 2009, 166–7).

Cretan tradition and who continued to adhere to the working practices and affiliations behind the masons' marks. Hence, rather than a vague range of emulative, diffusionist and migratory explanations for these Cretan features (for the spectrum of views, see Hägg 1982; Korres 1984), we would argue that it is worth being more explicit, and suggesting that a limited number of Cretan artisans were being sent to Pylos as part of courtly exchange and/or that they had moved there (voluntarily or under duress) in the aftermath of the Cretan LM IB destructions. We should not necessarily expect that this kind of exchange would leave a much wider cultural signature such as a foreign quarter to the town or widespread Minoanized lifestyles (although there are in fact other forms of evidence at Pylos), just as we see only very limited wider evidence for Minoan presence at Levantine and Egyptian sites who played temporary host to Cretan fresco-painters.

Another site that shows evidence of Cretan technological influence is Mycenae. Several blocks with Cretan masons' marks suggests, as at Pylos, that Cretan artisans may have contributed to early architectural phases about which we unfortunately know very little. The Atreus tholos makes use of three stone resources that would be very familiar to Cretan artisans: gypsum, probably from central Crete, *antico rosso* marble from the Mani and *lapis lacedaemonius* from near Sparta (Ellis et al. 1968; Younger 1987; Gale et al. 1988; Cavanagh and Mee 1999). The combination of hammer-dressing, sawing, tubular drilling and chiselling on frieze fragments and façade also fitted well within an established, previously strongly Cretan technical tradition (Wright 2006, fig. 1.4). A further good example is also provided by the stone vessel assemblage at the Mycenae Ivory Houses, which exhibits a narrow set of technical characteristics, such as multiple assembly and diagonal tubular drilling, that have no technical antecedents on the mainland and instead represent the narrow survival of one particular approach out of many in which Cretan artisans might go about making stone vessels (Bevan 2007, 163–5).

In the late 14th–13th centuries BC (Late Helladic IIIA2–B), there is a shift away from this investment in elaborate funerary monuments towards the construction of fortifications, bridges and dams (Hope Simpson and Hagel 2006). The motivations for this massive switch in investment are not something we address here, but it is worth stressing that it is likely to have required shifts in the scale of the labour force towards greater emphasis on larger work gangs overseen by only few specialists (Fitzimmons 2011). The new emphasis on roughly finished 'Cyclopean' walls is in step with this shift in labour profile. One hotly debated set of possible technological links is those suggested between Hittite Anatolia and the Mycenaean

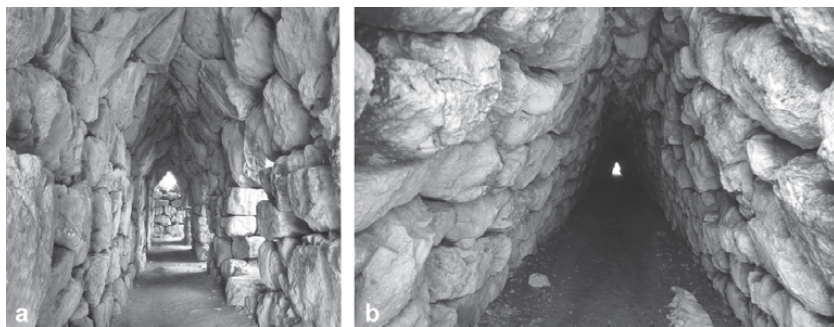


Figure 5.8 Corbel vaults: (a) at Tiryns and (b) Hattusa.

world. On its own, the adoption of Cyclopean masonry or the common choice of conglomerate for monumental portions of gateways is not a very good justification for these Mycenaean-Hittite links (Loader 1995; Maner 2012), especially in light of the very limited amount of portable material culture that we have identified so far as flowing between these two regions (Cline 1991). Even so, if we confine ourselves to a narrow range of technical procedures such as the hypothesised use of ‘pendulum’ saws, certain presence of drill-hole attachments and impressive parallels in corbel-vaulting techniques then the arguments are on firmer ground (Figure 5.8; Maran 2004; Maner 2012; also Seeher 2005; 2007). Moreover, this narrow range of shared techniques is matched by a narrow geographical spread, with most of the evidence coming from Tiryns and Mycenae in the Argolid on the one hand, and the central Anatolian capital at Hattusa on the other, suggesting that, again, direct court-to-court transfer of one or more specialists (who would then have to work with a local labour force) might be a better model (as argued by Maran 2004a) than a more general one of itinerant masons or a much vaguer one of broad cultural diffusion.

Conclusions

The discussion above has clearly only touched the surface of the range of stone-working evidence available to us from the Bronze Age eastern Mediterranean, but it nonetheless affords a clear view of specialists in motion, both within and between states, as well as episodes of technological transmission. We have emphasised the range of different ways in which individuals and groups acquire stone-working skills, share them with one another and/or retain these skills over multiple human generations. All of

this should serve as a strong reminder of what we stand to lose if we merely suggest that craft skills spread or diffuse in a formless way through time and space. Rather, we need to be more explicit about the social contexts and mechanisms by which people and ideas move around the Bronze Age eastern Mediterranean, even in cases where our interpretative agendas are very generalising and/or comparative ones.

6 | Towards an Understanding of the Origin of Late Bronze Age Greek Glass

ANDREW J. SHORTLAND

Abstract

Glass has been circulated widely in the Mediterranean throughout its late prehistory and history. The current chapter reviews the evidence on the technology and geographical distribution of glassmaking in prehistoric Mediterranean, aiming to shed new light on the question of local production of glass from raw materials in Late Bronze Age Greece.

Introduction

Although there are scatters of early glass that survive from at least the middle of the 3rd millennium BC (Peltenburg 1987; Lilyquist and Brill 1993), the first significant finds of man-made glass in the archaeological record occur in the 16th century BC. Traditionally, these early finds of glass have been ascribed to sites in northern Syria and Iraq (Beck 1934; Peltenburg 1987). This has largely been because of large amount of glass uncovered in the Stratum II destruction layer of the Late Bronze Age (LBA) Hurrian city of Nuzi (Starr 1937; 1939), which lies near modern Kirkuk. Early dates for this city suggested that the destruction occurred in the 16th century BC. Modern reviews of the dating evidence, however, have strongly suggested that Nuzi Stratum II should be placed in the middle of the 14th century BC (Stein 1989). This removes the most significant early dated finds of glass from the record and means that it is far less clear whether northern Syria has the earliest significant finds of glass or whether Egypt leads the way. However, it is probable that the few finds of early vessels and other fragments from Alalakh still represent the earliest glass and the best contexted material to date from before 1500 BC (Peltenburg 1987; Moorey 1994, 190).

Following the invention of glassmaking, glass spreads relatively quickly, with both Egypt and the Near East having significant quantities of glass objects by the end of the 15th and into the 14th century BC. It is during this latter century that the number of glass finds increase dramatically, especially at Egyptian sites such as Amarna and Malkata, but also in the Near

East where the glass is present, but perhaps never in the same numbers as in Egypt (Shortland 2012, 43–56). Rather curiously, just as the innovation spreads rapidly and becomes established, after around 1250 BC, the number of finds of glass dramatically reduce and by the end of the second millennium BC it appears that glass production has massively declined (Moorey 1994, 198; Shortland 2012, 169–73). There therefore remains a rather short flowering of this technology in the third quarter of the second millennium BC, and then it disappears almost completely.

Objects and Technology

The objects into which glass is fashioned include a wide range of small to medium-size artefacts. Most abundant are glass beads, either monochrome or, more rarely, polychrome, in a variety of shapes and sizes. Amulets and charms are also relatively common and these can include cult objects such as Ishtar figurines and Star pendants in the Near East and characteristically Egyptian amulets such as scarab beetles and wadjet eyes. Inlays are also common, both into wooden furniture and mortuary equipment and, especially in the Near East, into stone and mudbrick as architectural elements. Rarely, statues and busts of kings and royalty have been found. However, the most interesting use of glass is without doubt the core-formed glass vessels (Nicholson 1993). In an age before the invention of glass blowing, only two ways existed to produce a glass vessel. The first is to treat the glass just like stone and carve it using stone-working technology. This was perfectly possible to do, and rare examples of this do exist in the archaeological record, along with the occasional carved glass statue (Nolte 1968, 47). However, very early on in the production of glass it was realised that this was quite a wasteful technique, and that forming a vessel hot around a core represented another possibility. The technique therefore takes a core of dung and/or clay gathered around a copper alloy rod. This is dipped into molten glass and allowed to slowly cool, forming the basic vessel. Glass rods can then be manipulated plastic hot to add handles, or trailed onto the surface of the vessel and marvered flat to give decoration. After cooling, the core is then carefully chipped away to reveal the finished vessel (Nicholson and Henderson 2000, 203). This is by far the most common way for glass vessels to be formed in this period, and indeed the same technique continued to be used in the 1st millennium BC when glass started to be produced again.

All glass of this period appears to be of the same compositional type – it is soda-lime-silica glass (Turner 1956a; 1956b). The most common element

in the glass (after oxygen) is silicon and this forms the structure of the glass, the 'network former'. Silicon as silica, or quartz, either in the form of quartz pebbles or as pure sand, has a very high melting temperature, hundreds of degrees above what was possible in LBA furnaces. To make it melt to form glass, therefore, a flux has to be added. The flux accounts for the third most abundant element in the glass, sodium. In LBA glass this sodium is associated with significant amounts of magnesium and potassium. This pattern is characteristic of the use of a relatively impure sodium-rich flux and this is very likely to have been the ashes of salt tolerant plants, i.e. these are "plant-ash glasses" (Lilyquist and Brill 1993). Almost all of the LBA glass is deliberately coloured. Colour was obviously an important part, perhaps the most important part, of what glass was to the people who were manufacturing and using it. To create the colour various transition and other metals were used, either alone or with other compounds known as opacifiers that affect the translucency of the glass (Weyl 1951). Minerals or metals rich in copper (blue), cobalt (dark blue) and manganese (purple and black) created the basic colours, and antimony (white, or light blue with copper) and lead with antimony (yellow, or green when with copper) were the opacifiers. The final colour, red, was again produced mostly with copper, but manipulated in a different way to create cupric (Cu^+) red rather than cuprous (Cu^{2+}) blue/green (Shortland 2012, 97–119 and references). In addition to this basic three-component system (silica, flux and colorant), these glasses also may have had calcium in the form of limestone or shell added to them. Since the workshops would have been far from clean systems, there is also the probability of a series of contaminants finding their way into the glass, including clays from crucibles or with the plant ash, grinding debris from crushing the raw materials, and stray material that might have been lying around in the workshop and might accidentally have found their way into the melt (Shortland et al. 2007). Similarly, other materials might have been deliberately added for ritual reasons in small quantities that might now be difficult to detect in the complex series of components that are known to have been added.

Provenance

There is the potential for all these different components that are added either deliberately or accidentally during the glassmaking process to create key, identifiable markers that might distinguish different glassmaking workshops or at least different glassmaking areas from each other. Much

work has been devoted to distinguish whether different workshops might produce glass that is subtly different. In terms of most elements, particularly the major elements such as silicon, calcium, sodium, magnesium, potassium and iron, which when expressed in the standard oxide form might make up as much as 98 per cent of the glass, LBA glass is very uniform, with very little consistent variation that can be detected between the different areas where it can be found (Jackson 2005). Similarly, the colouring elements (copper, cobalt, manganese, antimony and lead) seem to be employed in very similar ways to produce very similar colours. It is only in trace elements analysis that much success has been achieved in distinguishing between glass found on different sites. These trace elements can be divided into two types: those that are thought by most to be associated with the colorants, and those that are associated with one of the other components, although some doubt often remains which component they might be associated with.

Some of the colouring elements are associated with other elements. The easiest example is copper, which in a significant number of (but not all) Egyptian blue glasses is associated with tin, with a ratio of copper to tin roughly the same as those of contemporary bronzes (Kaczmarczyk and Hedges 1983, 78–94; Shortland and Eremin 2006). This is not seen in Near Eastern blue glasses. The implication here is that while the Near Eastern and some Egyptian glasses use a copper metal-based colorant, in Egypt this is frequently replaced with a bronze metal. Cobalt colorants seem to exist almost exclusively in glass found in Egypt and in the Greek world, and to be very rare in the Near East. At least in Egypt (Greece being discussed below), the cobalt seems to be associated with a range of other elements including some or all of aluminium, manganese, nickel and zinc. This has been traced to the use of a cobalt alum as the source of the cobalt colorant in Egypt (Kaczmarczyk 1986). Similarly, other suggestions have been made as to the source of the lead in yellow and green glasses (Shortland et al. 2000).

More significant, however, are those trace elements that are not associated with the colorants. Some of these, notably titanium, zirconium, lanthanum (and other rare earth elements) and chromium, seem to consistently vary between glass that is now found in Egypt and that found in the Near East (Shortland et al. 2007). The pattern is very uniform and clear and seems to represent a relatively easy way to tell glass found, and by implication made, in those two areas. Exactly how this pattern comes about is a question of debate, but it is probably linked to the geology of either the clays or the rocks used in the two areas. Whatever the direct causal link does not

really matter here, suffice it to say that the Near Eastern glass and that from Egypt can be distinguished by trace element content.

Evidence for Exchange of Glass

The evidence for the exchange of glass between states in the LBA is extensive and discussed at length in Shortland (2012, 139–69). The evidence comes in widely differing forms. Some of the most important is that derived from surviving texts, especially the Amarna letters (Moran 1992). Equally significant is the evidence from Egyptian temple and tomb scenes, where offering and tribute is being given either to the Egyptian king or by the Egyptian king to the temple concerned (for example, the Hall of the Annals at Karnak, described in Wreszinski 1923–40). There is also archaeological and object evidence for exchange, including core-formed vessels that some commentators have interpreted as having foreign styles but found in Egyptian contexts, for example, Nolte (1968, 50).

However, perhaps the best evidence for exchange of glass comes from the Ulu Burun shipwreck, found off the southwestern coast of Turkey near Kas. Dating to the last years of the 14th century BC, this shipwreck contained 175 glass ingots, mostly dark blue and turquoise, with one purple ingot, a total weight of around 350 kg of glass (Yalcin et al. 2005, 69). Analysis of the glass in the vessel (Brill 1999) shows that the dark-blue glass was cobalt coloured and had the aluminium, manganese, nickel, zinc signature that characterises the Egyptian alum source. The turquoise glass was copper coloured and was more difficult to provenance. Jackson and Nicholson (2010) managed to analyse three ingots, two dark blue and one turquoise. All three ingots fell into the Egyptian field identified in Shortland et al. (2007), suggesting they were of Egyptian origin. More analyses are needed of these ingots, but this is enough to suggest that at least some of the ingots, both dark blue and turquoise, come from Egypt.

Greek Glass

The discussion above has deliberately missed out another area where LBA glass is found in quantity, the Greek world. Glass appears in relatively large quantities in the Late Helladic IIIA period, where it can be linked through ceramic evidence to the Egyptian kings Amenophis III and Akhenaten along with the Ulu Burun wreck, discussed above (Nightingale 2002). The

characteristically Greek object in glass is the relief bead, a flat, rectangular plaque usually in blue glass with a moulded decoration of dots, swirls and other abstract patterns. Sometimes hair appears to be depicted and rarely zoomorphic images. These are absolutely typical of Mycenaean finds and found almost nowhere else. Other shapes of glass bead and inlay are known in the Greek world, including inlays to swords and other items and rare female plaques. However, that key object so typical of Egypt and to a lesser extent the Near East – the core-formed vessel – is relatively rare in Greece, Nightingale (2002) listing the few sites that are known. These vessels are usually considered as imports from Egypt or the Near East.

The main question for debate is where the glass used in the majority of the Greek objects, especially the relief beads and other plaques and inlays, was made. It is clear that the glass was *worked* in Greece. There are finds of open moulds that were probably used to manufacture the relief beads from Knossos and Mycenae (Nightingale 2002), which were clearly used for moulding glass. The glass was therefore transformed into the typical Mycenaean objects, found virtually nowhere else, only in Mycenae, Knossos and elsewhere in the Greek world. However, where the glass was *made* from its raw materials is a different matter. Ulu Burun gives us very clear evidence that glass was transported in large quantities by ship during the LBA. This glass was in the form of coloured glass ingots, which could relatively simply be worked into any objects that might be desired. Analysis of major and trace elements strongly suggests, supported by archaeological evidence, that ingots such as these were made in the established glassmaking centres of Egypt and the Near East. Egypt seems to have produced all the dark-blue, cobalt coloured ingots and some or all of the lighter blue copper coloured ones on the Ulu Burun wreck, and the Near East may be responsible for some of the remaining copper blues, although none yet has been identified at Ulu Burun. However, what about the glass that has been found in Greece itself?

Several studies (Sayre and Smith 1974; Brill 1999; Panagiotaki et al. 2005) have shown by various techniques that a lot of the dark-blue glass from Greece is cobalt coloured and contains similar trace elements (aluminium, manganese, nickel and zinc) to the Egyptian cobalt coloured glasses, however, relatively few analyses have been carried out. This was rectified by Nikita and Henderson (2006), who analysed eighty-one glasses from Elateia and eight from Thebes. Some of these glasses are later and some are of the mixed alkali composition associated with glass from further west in mainland Europe. However, most were of the same soda-lime-silicate composition seen so commonly in Egypt and the Near East. Certainly

their major element composition falls within the general range of that found in those areas, and most are coloured with cobalt, copper or cobalt and copper – very similar again. However, Nikita and Henderson (2006) see a range of new types of cobalt colorant in these glasses, characterising three new types of cobalt colorant in the glasses from Thebes and two new ones from Elateia. This interpretation rests on low levels of those same trace elements, aluminium, manganese, nickel and zinc, that are found in Egyptian glasses. They add arsenic too, a volatile element sometimes seen in Egyptian cobalt blue glasses, which is seen at the same levels occasionally in the Greek glasses. They classify multiple cobalt colorant types and suggest that these are evidence for different cobalt sources. They conclude that the compositions of the Greek glasses analysed in the paper “differ considerably from those of contemporaneous plant-ash glasses made in Egypt and Mesopotamia” (Nikita and Henderson 2006, 119). They sum up that the “analytical evidence suggests that a glass industry in Mycenaean Greece could have operated in Mycenaean Greece ... [and] ... raw plant ash glass (HMG) may have been manufactured in Thebes” (Nikita and Henderson 2006, 118). However, the evidence is from analyses derived from a micro-probe that is at the very limit of its detection, and the groups fall within the range of those seen in Egypt. The conclusions are at best therefore uncertain, but will be discussed again below.

In contrast, a study of Mycenaean glass carried out by Walton et al. (2009) concluded that these glasses fell within the range of major element composition seen in the Egyptian and Near Eastern glasses. Not only that, but of the eleven samples analysed, six (all four cobalt coloured and two copper coloured) were entirely consistent with the Egyptian trace element patterns discussed above and the remaining five copper coloured glasses were entirely consistent with the Near Eastern pattern. As such the Egyptian glasses match very precisely the pattern seen in the Ulu Burun ingots discussed above. All the Mycenaean glasses in the study by Walton et al. (2009) were therefore entirely consistent with being imports to the Greek world.

Isotopes and Reinterpretation

Almost coincident with the work on trace element analyses for these early glasses, the work on isotopic analysis was beginning. This work began in Belgium (Degryse et al. 2010) and was quickly supplemented by more data from Henderson et al. (2010). Both studies used a combination of neodymium and strontium isotope analysis and both studies agreed that Egypt and

the Near East were very distinct. Nd and Sr isotopes are therefore another marker, just like the trace element analyses, that enabled Egyptian and Near Eastern production to be distinguished. A combination of the two techniques (which to date always seem to agree) offers good discriminatory power for these two areas. Only Henderson et al. (2010) contained isotopic analyses for Greek glasses, actually glasses previously analysed in Nikita and Henderson (2006). However, the interpretation of these glasses seems to have changed in this later paper. The paper reports that “Greek cobalt blue moulded glass plaques, similar in chemical composition to contemporary Egyptian glasses (Nikita and Henderson 2006), were made out of raw glass imported from Egypt... one turquoise bead was exported from Mesopotamia to Mycenaean Greece” (Henderson et al. 2010, 16–17). Hence now the similarities of the glasses are being stressed instead of the differences, leading to a complete change in the conclusions drawn. However, as all groups working on this material would accept, the fact that no glass has so far been found that can be positively identified as made in Greece does not mean that it was certainly not being produced: the old archaeological adage applies, “absence of evidence is not evidence of absence”. However, it now appears that most are agreed that on current evidence there is no evidence of local production of glass from raw materials in Greece.

7 | Mobilities in the Neopalatial Southern Aegean: The Case of Minoanisation

IRENE NIKOLAKOPOULOU AND CARL KNAPPETT

Abstract

The plentiful circulation of many kinds of materials across the southern Aegean is one of the hallmarks of Minoanisation that all scholars can agree upon. However, what this circulation means in terms of the mobility of people is still very much debated. Are we to think that entire groups of people migrated from Crete to set up colonies across the wider region? Or should we instead imagine just enough circulation and contact for different groups to exchange goods and imitate certain objects and practices? Here we seek to contribute to this debate by assessing two technologies that appear to have been developed on Crete and then transferred in some way across the southern Aegean: fresco wall painting, and aspects of pottery production techniques, such as wheel-fashioning. Such technological practices require extended periods of learning, and perhaps even apprenticeships. We consider what the acquisition of such technologies – surely implying extended exposure to skilled artisans – suggests for the social mobilities underwriting Minoanisation.

Introduction

Between around 1750 and 1450 BC, many communities across the southern Aegean, principally in the Cyclades, Dodecanese and coastal western Anatolia, are ‘Minoanised’. That is to say, the material culture of these communities starts displaying traits more typical of Minoan Crete; fine decorated pottery, usually imported from Crete, is the principal feature recognised archaeologically, with other kinds of ‘everyday’ Minoan pottery, such as conical cups and tripod cooking pots, copied locally. Minoan architectural styles, such as pier-and-door partitions, are also ‘mobile’, as are styles of wall painting. Strikingly, this ‘Minoanisation’ entails changes not only in

consumption, but also in production, with the local adoption of technological practices already in use on Crete. It is not just that Minoan pottery styles are adopted, but that they are often made with the potter's wheel, in communities where this technique, long established on Crete, would have been quite novel. The architectural changes are not just stylistic, since distinctively Minoan building techniques are also used, such as the integration of ashlar masonry and timber. And the extensive wall paintings at Akrotiri on Thera, and at other Minoanised sites, are made with lime plaster, a technology typically encountered in Cretan elite buildings, especially at Knossos. This is not to mention further strands of evidence, such as the uptake or adaptation of weaving techniques for making fine textiles, and methods and materials for manufacturing tools and vessels in stone and metal. This complex combination of traits and practices calls out for explanation and interpretation; and yet, it is noticeable that scholars have grown quite cautious, as epitomised in Broodbank's definition of Minoanisation (2004, 46) as "a modern term of sometimes deceptive convenience for a heterogeneous range of ancient material culture traits and practices that indicate the adoption in places beyond Crete, through whatever means, of ways of doing things that originated directly or indirectly within that island".

Existing Approaches

Of course, the term 'through whatever means' quietly avoids the vigorous disagreement concerning the underlying processes of Minoanisation. We can bluntly describe it as a stand-off between colonisation and acculturation, long trapped in an impasse (Broodbank 2004; Macdonald et al. 2009), though there are signs of more nuanced approaches emerging (see below). To summarise, the colonisation model maintains that the Minoan features seen beyond Crete (from Kythera in the west to the coastal Anatolia in the east) are so numerous, and in many cases requiring such in-depth knowledge of Minoan ways, that the only plausible explanation is that they were in fact propagated and used by Minoans, who emigrated to the various sites in question (principally Kastri, Akrotiri, Ayia Irini, Phylakopi, Trianda, Seraglio, Miletus and Iasos). The 'acculturation' model posits that local communities willingly or by necessity adopted various aspects of Minoan cultural practices, employed perhaps for prestige, and thereby participated in the moulding of new identities and affiliations in the Neopalatial period.

These models represent two extremes and leave ample ground for intermediate views. We need to take the most useful elements from each perspective.

On the one hand, the colonisation model has the advantage of recognising human mobility (Branigan 1981), even if it tends to be unidirectional, envisaged as a demographic expansion outwards from Crete, driven in part by the need to acquire additional (metal) resources. On the other hand, the acculturation model can absorb much more satisfactorily the ample evidence for continuity in local traditions at Minoanised sites, not to mention the pronounced regional and chronological variation in the differential uptake of Minoan practices in the Anatolian, Dodecanesian and Cycladic traditions. And yet, it is itself vague on patterns and processes of mobility. Modified intermediate positions are now appearing; for example, even though Davis and Gorogianni are committed to the importance of local processes in the Cyclades, they recognise that some Cretans may have been mobile, especially craftsmen and craftswomen (Davis and Gorogianni 2008, 347). This is also a significant component of Cutler's recent work on textiles, arguing for mobility of craftswomen (Cutler 2011). Momigliano (2012) has also developed such an intermediate position in presenting her new work on the Iasos material, and one might also consider here recent contributions concerning Phylakopi on Melos (Whitelaw 2005), and Aya Irini on Kea (Abell 2014).

These modified positions start to offer the possibility of not only recognising that some forms of human and technological mobility must have been in play, but also that the variations, nature and degree of mobility may account for some significant patterns in the data, i.e. local continuity, regional variation and local adaptations. Part and parcel of these new intermediate perspectives is seeing the need to examine not only objects but also techniques.¹ What this also does is bring the question of Minoanisation down to the level of individuals and their communities of practice – a shifting between scales of analysis that has not been a strength of either of the previous polarised approaches. For both colonisation and acculturation, the argument has been largely a macro-scale one of how one culture influences another. We need to pay attention to the macro-scale of course, but find ways to infiltrate it with more micro-scale concerns of human mobility. One solution we propose is to use an intermediate stage between the

¹ This has been through the influence of ethnoarchaeology and the anthropology of techniques, one important observation of which has been that neighbouring groups are often well aware of each other's technological practices while choosing not to adopt them (Lemonnier 1986, 161). Tool functions and material constraints also structure and determine these choices, but they do not sufficiently explain the material variability often observed. Thus, the absence of any particular technical trait is not necessarily attributable to a lack of knowledge, but instead may signify a strategy marking social difference (e.g. Lechtman 1977; Lemonnier 1986; 1992; 1993; Pfaffenberger 1992).

macro- and micro-scales, i.e. the meso-scale of the community. This can serve as a bridge between the otherwise widely separate levels of individual and society (see also [Hilditch 2009](#); [Bevan and Conolly 2013](#)). We seek to demonstrate two points through this multi-scale approach: first, that Minoanisation was a distinctive combination of technological, human and social mobilities; and second, that through this active process of combination numerous local solutions and adaptations were generated.

A Multi-Scale ‘Learning’ Model

What our multi-scale model is based around is learning (see Knappett and van der Leeuw 2014). If we are to understand transmission processes, then we should recognise that the transmission of technological practices in particular requires learning (see also [Broodbank 2004](#)). Emulation models for the imitation of static stylistic and typological traits in material culture are inadequate (on style, see [Wobst 1977](#); [Sackett 1982](#); 1990; [Wiessner 1983](#); 1984; [Hegmon 1992](#)). At the micro-level, an individual has to learn how to make a pot on a wheel or prepare plaster; and these may not be easy skills to master, requiring concerted and extended periods of learning (e.g. [Crown 2001](#)). Such periods of learning, or apprenticeships, are invariably structured within ‘communities of practice’ (see [Wenger 1998](#)). Individuals learn within communities. And then what we must also be alert to is the ways in which technological knowledge moves between communities in certain circumstances (see [Gosselain 2000](#)). There can be many variations according to the nature of the practice to be learnt, the constitution of the community of practice, and the character of the connections between communities.

In other words, it is the adoption of new technological skills through learning which enables the spread of Minoan practices, and the integration of new techniques within long-standing traditions. Therefore, thinking about the varied mechanisms of learning should help us penetrate some of the complex modes of human mobility that underscored Minoanisation. Proceeding now on a case-by-case basis, we may most effectively see what kinds of mobility are implicated in different practices.

Mobility of Minoanising Technologies

Technological novelties or adaptations to Minoan practices are conspicuous in wall painting, pottery manufacture and building techniques. Some

practices may have been relatively restricted, such as the use of written and stamped documents (Karnava 2008), or certain aspects of architectural design, such as ashlar masonry, the use of timber (Tsakanika-Theochari 2006) and pier-and-door partitions (Palyvou 2005). Others may have had a gendered dimension, with weaving on an upright loom with the ubiquitous discoid type loomweights part of female labour practices (Cutler 2011). Long-standing Cycladic traditions, such as working metal and stone into impressive artefacts, sooner or later merge with new skills and the introduction of novel materials in order to produce Minoan-type artefacts.

In order to take an integrated look at the process of transfer and adoption of new technologies, we choose to expand on two particular fields of craft activity, wall paintings and pottery, for a number of reasons. First, the state of preservation and abundance of material allows thorough study and reconstruction of all stages of the *chaîne opératoire*, from the extraction of raw material to the consumption of the finished product in a defined spatio-temporal context. This is not always the case with other crafts, such as weaving (where we lack the evidence for the finished product) or stone and metal vase making (where the procurement of raw material may be subject to natural resource limitations). Second, wall painting and pottery manufacture offer a more tangible, empirical grasp of what transmission of technology involves, in that we are able to discern levels of apprenticeship and integration of novelties into pre-existing practices, by assessing the results of deliberate faithful reproduction or hybrid creations. Again, this is apparently not possible for other crafts, where we lack solid comparable material evidence for previous periods (the Middle Bronze Age) or for localised workshops, e.g. in stone or metal vase making, so that a diachronic comparative approach is limited.

Wall Paintings

Although by definition immobile, wall paintings have been treated as a prominent aspect of Minoan influence, due to their intrinsic capacity to express artistic trends and to project ideology and status. From the present evidence, it seems that true lime plaster murals were not produced in the Cycladic islands during the Middle Cycladic (MC) period (c.2000–1700 BC) and that they make their appearance in early Late Cycladic (LC) I (i.e. Middle Minoan (MM) IIIB–early Late Minoan (LM) IA in Cretan terms – c.1700–1650 BC). A remarkable exception may be noted at Trianda, where traces of coloured plaster are preserved in a building with a polythyron preliminarily dated to MM IIB (Marketou 2009). Large-scale figurative mural

painting reaches its floruit in the Cyclades in LC I, and the astonishing preservation at Akrotiri has enabled detailed observations on technological issues. The essential constitutive technological element for the creation of wall paintings lies in the production and application of lime plaster, involving the procurement of appropriate raw material, its firing in task-specific kilns and the final treatment before application on a prepared substratum of the wall. While there is as yet no conclusive evidence for ancient quarrying of lime in the island of Thera or for lime kilns, plaster ready to use was found in locally made vases and baskets at Akrotiri (Marinatos 1973, pl. 59a; Nikolakopoulou 2003, 570). Analyses show that the pigments come from naturally occurring sources, with the exception of Egyptian blue, and some of which are procured locally whereas others are clearly imported (Perdikatsis et al. 2000). The use of tools for treating and organising the surface and drawing outlines is also attested, such as pebbles for burnishing, string marks for the definition of border lines, incisions and possibly a type of stencil for repetitive drawing of curved elements (Birtacha and Zacharioudakis 2000). Analytical results suggest that both secco and buon fresco techniques were applied in all sites, while, as far as the preparation of the plaster and the nature of the pigments is concerned, similar materials and techniques were used in general in the contemporary sites of the Aegean (Perdikatsis et al. 2000; Chryssikopoulou et al. 2000; note differences with Mari in Sherratt 2000, 129). In fact, there is not much to distinguish between plaster techniques in technological terms when found anywhere in the Aegean; the only difference lies in the purity/quality of the lime plaster and pigments used, but different qualities can be found in the same place (Georma personal communication). In particular, the Akrotiri frescos are of exceptional quality, made of pure lime plaster, quality pigments and bonding materials (and these remarks do not derive from the state of excellent preservation) (see Georma 2009). This exceptional quality may lead one to suggest a particular link in technological terms with Knossos fresco production, but this remains a risky association.

How did the islanders learn and adopt the manufacturing stages and technical skills required for wall painting? On the one hand, the acquisition and application of the requisite technical skills point to a targeted and internalised process of learning and social interaction. On the other hand, stylistic elements and the repertoire chosen for depiction apparently draw from a pool of Aegean artistic trends of the period, reflecting a shared milieu in the spheres of ideology and ritual. These elements are the most visible as a result of emulation, and certainly stand for more superficial, situational and temporary facets of identity. An informative research avenue has mainly

focused on the recognition and evaluation of specific workshops active in individual settlements and the issue of the mobility of itinerant painters. In the case of Akrotiri, it has been suggested either that Therans learned their art in a Minoan workshop and returned home to impart their knowledge to their assistants, or that this art was transferred to Thera by itinerant Cretan painters who worked on the island (cf. [Televantou 2000](#)). Most scholars concentrate on the artistic autonomy of local workshops in relation to Crete and on distinguishing the hands of individual painters (cf. [Televantou 1992; 2000](#); see [Boulotis 2000](#) for a review on the transmission of fresco painting and travelling, visiting or itinerant painters, with references). If we accept that local styles are identified in the Thera frescos, with one prominent element being the use of white background in accordance with the Cycladic pottery tradition and in contrast to Cretan dark backgrounds in frescos, we are looking at an elaborate hybrid picture of craft mobility and integration of new practices. However, the identification of different styles in wall-painting execution shifts the emphasis away from the basic fact that a high level of specialised technical knowledge was required from the very beginning for the execution of these wall paintings.

Lime plaster production has a long history in the Aegean, especially on Crete where it is commonly found from Early Minoan (EM) II (e.g. The Red House at Vasiliki, [Zois 1976](#); see also [Jones 2005](#), 203). At Akrotiri, sparse fresco fragments with linear patterns identified as substrata of the Late Cycladic (LC) I wall paintings testify to the mastery of skill in lime plaster preparation and application already in early LC I, if not earlier. It is the combination of craftsmanship in the plaster preparation and artistic skill in the painting, first encountered in Crete in the early Neopalatial period, that constitutes the phenomenon of figurative mural painting, widely adopted and adapted in southern Aegean communities by Late Bronze (LB) I. At Akrotiri, the local community had already experimented successfully in large-scale painting on Middle Cycladic (MC) pottery ([Marthari 2000](#); [Papagiannopoulou 2008](#); [Nikolakopoulou 2010](#)), so the novelty lay in the combination of this with lime plaster technology, innovative building techniques and a new approach to the arrangement and use of space. Coupled with the fact that wall paintings were widely distributed through most of the houses at Akrotiri, and exhibited stylistic variation, the process of innovation seems deeply embedded in the community, rather than being a superficial and situational emulation of styles and techniques from Crete. This concerted approach to a new way of making things in a local context surely means the artisans were Therans rather than Cretans, which in turn implies a period of apprenticeship undergone by local craftspeople to learn

the requisite skills (in painting, plastering and conception of architectural space). Apprenticeships in these skills would have meant extended exposure to Cretan artisans; whether it was Thera craftspeople travelling to Crete, or the same artisans receiving their training from Cretan artisans visiting Thera, the mobility implied is considerable. Irrespective of the exact forms of mobility involved, local craftspeople soon left their novice status behind, and acquired the capacity to adapt their new skills to produce imitations, hybrids or entirely new creations, as is also the case for pottery products discussed below.

Pottery

Turning to pottery production, Cycladic and Dodecanesian communities exhibit long and elaborate pottery traditions, with strong indigenous elements as well as selective adoption of external influence, as a result of their integration in interaction networks from the Neolithic period onwards. As noted by Gosselain, technical acculturation leads usually to the incorporation and independent development of varying pottery traditions in societies or communities that may otherwise appear as culturally homogeneous (Gosselain 2000, 206). It is during the early Neopalatial period that incidental contact with Minoan Crete transforms into intensified interaction and the beginning of Minoanising influence (Knappett and Nikolakopoulou 2005; 2008). This change is apparent in three fields: first, the increase in number of imports from Crete and the typological and stylistic imitation of Cretan pottery in local Cycladic fabrics; second, the adoption of pottery consumption practices, which reflects a deeper level of penetration of the Minoan 'way of doing things' into everyday life; and finally, the implementation of Minoan technological traits and skills in pottery production.

Imported pottery must have played a key role in the initiation of ceramic technology transfer, establishing familiarity with different taste and trends and standing for a mnemonic device carrying embedded information on manufacture, function and status (cf. Kopytoff 1986; Gosden and Marshall 1999 on the biography of objects). Certainly, the mastery of new manufacturing processes requires a period of close interaction between craftsmen, rather than occasional informal contacts, a condition that was obviously met in late Middle Bronze Age (MBA) southern Aegean interaction networks. The typological and stylistic imitation of Cretan pottery has been considered as the banner for Minoanisation at most sites, where other relevant evidence is not preserved. At Akrotiri and Phylakopi the impact of imported MM III Cretan pottery on local pottery is probably more pronounced, as

there we witness, apart from the imitation of shapes and motifs, a conscious attempt to imitate dark surface treatment with white elements. This feature stands out in the local production of light ground pottery and best exemplifies the impact of metallicising Cretan imports on local taste in the first stages of interaction in the early Neopalatial period. In LB I the assemblages have a more uniform appearance, as Cretan production also moves into the dark on buff ground wares. Similar to the wall paintings as a medium to express stylistic and cultural attributes, ceramic artistic expression manifests local peculiarities in the adoption of Minoanising features. We only have to look at examples from sites such as Kythera, Phylakopi and Akrotiri to see that emulation of Minoan motifs at each site is creative and distinctive and even reflects varying levels and degrees of imitation and competence in the execution.

New ceramic types are closely associated with new patterns of consumption. This change is evident in the serving and drinking habits, with new types of vases such as the bridge-spouted jars, the ewers, and a variety of Minoan-type cups, coming into the picture, occasionally appearing in sets in late MC (Knappett and Nikolakopoulou 2008). A similar case can be made for the adoption of the tripod cooking pots, which were used together with the traditional footed vessels, a practice which points towards the diversification and enrichment of food preparation and consumption. Similarly, rhyta, which only appear *en masse* at Akrotiri in LC I levels, suggest the taking up of formalised pouring practices associated with ritual, which although pre-existing in social life from at least the MC period, as testified by numerous jugs, apparently intensify and transform according to Minoan guidelines (Nikolakopoulou 2010). Along these lines, the potential for mass-production and standardisation of pottery manufacture is fully explored only during LC I as a response to increased needs and a codification of the quality and quantity of exchange goods.

In the realm of technology, the most significant innovation by far is the adoption of wheel-fashioning, albeit for limited numbers of vases in the early Neopalatial period. These are mostly Minoan types, such as ledge rim bowls and straight-sided cups, as exemplified at Akrotiri (Knappett and Nikolakopoulou 2008). At the same site, two more novelties are attested in pottery manufacture. The first is the substitution of manganese with iron oxides for black slips and paint, as demonstrated by analyses conducted on late MC/LC I pottery (Kilikoglou et al. 1990). The second concerns the new ways of mixing clay for cooking pots, and possibly other coarse wares, using techniques and materials that strongly invoke salient Cretan fabrics, as shown in the analytical work of Hilditch (2009) and Müller (2009). This

new practice clearly shows that the significance lies not in the slavish imitation of a new type, the tripod cooking pot, but a move towards optimisation of function and understanding of firing and thermal resistance qualities (Roumpou et al. 2013).

Some ethnoarchaeological research suggests that, while decorative techniques are more receptive to borrowing, clay mixing and fashioning are the manufacturing steps most resistant to change in the pottery *chaîne opératoire* (Gosselain 2000). Although more work is needed on the chronological aspects of when ceramic technological changes came into play at each site, there is an evident shift towards the adoption of Minoan craft and motor skills, fully established by LC I. This is not to suggest that local potting traditions vanished; on the contrary, they account for the high degree of visibility of local products in the extended exchange networks of the southern Aegean. Yet, the adoption of less salient and less technologically malleable features, such as wheel-fashioning and paste preparation, forces us to explore the reasons behind the mechanisms of learning and practising new skills. Without turning to rigid cultural historical schemes, we cannot help but notice the abrupt appearance of Cycladic imports in Minoan Crete, and especially Knossos, in the early Neopalatial period. Could this change be associated with an increased mobility of craftsmen eager to literally put their hands on new skills in the context of forming a new social identity? And perhaps, the manifestation of 'becoming Minoan' is more evident in the field of ceramic manufacture than in any other craft. The introduction of new technical elements into a long-standing practice, with extended penetration in all societal classes, is probably more challenging conceptually than the adoption of an entirely novel practice, such as mural plaster painting.

Discussion: Technological Mobility through Space and Time

It is hard to see how some of these technologies could have been adopted other than through extended exposure to skilled artisans. This in turn means we have to imagine artisans of various kinds having considerable mobility across the southern Aegean. And this does not just mean human mobility through geographical space, but also social mobility: it is one thing being able physically to travel from Crete to the Cyclades, but quite another to be able to integrate sufficiently to allow for the kinds of concerted learning that such technologies demanded. This also raises a series of further questions. How 'exposed' were island communities and local craftsmen to

technological advances implemented in Crete? Why would local communities have wanted to ‘adopt’ these advances and why would artisans have been motivated into such mobility for this purpose? And what does the differential uptake of technologies over time have to do with patterns of mobility? For example, did mobility increase in LM IA, a result of a more interconnected social and cultural world, perhaps facilitated by advances in maritime technology? Did this in turn thereby facilitate the learning of more complex technologies such as fresco painting, and bureaucratic techniques of sealing and writing? Or was, perhaps, the interconnected ‘network of objects’ of Neopalatial Crete itself in part responsible for this new-found mobility across diverse communities (Knappett 2011a; 2011b)?

Learning processes inevitably make us think about the acquisition of skills, and how some technologies demand much higher levels of skill than others. We should distinguish between the introduction of entirely novel crafts and techniques, and the adaptation of pre-existing practices through the addition of new skills. In some island communities during the early Neopalatial period, new ways of cooking, weaving and pottery manufacture are apparently adopted by the broader population. But the processes of technological adoption are drawn out over time: some innovative Minoan technologies arrive later. More complicated skills in technological terms, such as wheel-fashioning and wall painting, take more time to become common assets. Perhaps the early occurrence at Akrotiri (Vakirtzi personal communication) and Ayia Irini (Overbeck 1989, pl. 23c; Abell 2014) since the early MC of discoid/oval loomweights is an indication that weaving practices were a more easily transferred skill, or that mobility of female labour followed different lines to other kinds of mobility. This may seem surprising, but only because of our tendency to focus our gaze on the ‘acme’ of Minoanisation as represented in the well-preserved finds from Akrotiri at the time of the Theran eruption. While *eventually* at some sites we might see a full ‘package’ of Minoan technologies, they seem to have been adopted gradually over time (Nikolakopoulou 2009). Therefore, a diachronic perspective serves to correct the illusion of an integrated, unified episode of technological innovation.

Acquiring skill takes time, and hence investment. These are the kinds of knowledge that normally require drawn-out apprenticeships, often through inter-generational transmission. Motor habits require extensive practice and they prove to be especially resistant to change. As noted by Gosselain (2000, 209–10), different components of pottery *chaînes opératoires* do not share the same technical fluidity or processes of social interaction. Decorative techniques can be adopted through post-learning interactions,

as a particularly visible and technically malleable category, likely to reflect wider and more superficial categories of social boundaries. Fashioning constitutes a very stable element of pottery traditions and is expected to reflect the most rooted and enduring aspects of a potter's identity.

Moreover, learning involves a set of interactions that play out across space as well as time – learning is an individual bodily process of skill acquisition, but can also be seen at a community and inter-community level. By identifying spaces of shared technical knowledge we move beyond the narrow explanatory schemes of spatial/geographical proximity and, consequently, beyond models of transfer by institutionalised forms of encounter such as colonisation or trade patterns. The literature on communities of practice (Lave and Wenger 1991; Wenger 1998) as prime knowledge-generating environments explores the possibility of recognising spaces of knowledge that draw on far more than spatial proximity, sharing in fact 'sociotechnical aggregates' (Gosselain 2000, 190). As Hilditch (2009) has demonstrated in her work on MC pottery manufacture, communities of practice can operate at different scales, and certainly coexist in one site, such as Akrotiri, where the slow uptake of novel pottery manufacture techniques occurs in a very limited range of shapes and is fully integrated within the local production sequence using local raw materials. In this context, decentred or distanced learning would have resulted in distinct local communities of practice in the prehistoric Aegean (as currently emphasised in the literature on corporate learning), as evidenced by the degree of technical knowledge coherence across different sites. In this learning network, other parameters may be at work, such as frequency, fidelity and directionality of information channels, rather than spatial distance (cf. Amin and Cohendet 2004). For the Aegean in the Neopalatial period, this could mean that there are various communities of practice, not all of which are directly connected to Minoan Crete. Momigliano (2012) has suggested that Iasos might have been more a part of local small-world networks in the east Aegean, interacting much more frequently with settlements like Miletus, Seraglio and Trianda than with Crete. In this way we have to think of various indirect effects of Minoanisation, especially to counteract the ways in which the term itself inevitably makes us think directionally of effects emanating from Minoan Crete. The resultant 'new environment' (Davis and Gorogianni 2008, 339) is then not necessarily created directly by Crete/Knossos, but probably consciously and perhaps even competitively sustained by all communities involved.²

² Relevant to these points is the discussion on the concept of 'Romanisation'; see Woolf 1998, 15, on the role of culture contact, cultural brokers and the nature of the indigenous society in

The different forms of interaction in turn point to many different currents of human mobility. For example, how far can we go in exploring the directionality of technological transfer in terms of human mobility? Is it Cretan craftsmen who travel or even migrate to the islands and teach their skills or is it islanders who arrive on Crete, or even at Knossos in particular, for a period of apprenticeship, and then return to their homelands and set up new workshops? A hint may be offered by the different outlook of Minoanising pottery at two sites, Kythera and Akrotiri, where the faithful reproduction of Cretan ceramics in the former compared to more hybrid forms in the latter may suggest a differential involvement of Cretan craftsmen in terms of actual presence in the sites. That said, we cannot fail to notice that major shifts in technological practice occur almost simultaneously in southern Aegean island sites in the late MBA and that henceforth Minoanising material culture manifestations and associated practices are attested simultaneously in major island sites until the expansion of Mycenaean influence.

Conclusions

Unpicking in great detail the exact movements of ancient artisans is of course beyond us with such indirect evidence. Nonetheless, the transmission of technological practices that falls under the banner of 'Minoanisation' offers much potential for research into learning mechanisms and human mobility. Minoanisation certainly deserves renewed attention, not simply as the manifestation of highly visible cultural attributes shared through exchange and interaction networks. By taking a more technological approach, as outlined here, we can begin to tackle how the materiality of Minoanisation was dynamically generated and reproduced. We need to acknowledge that a significant facet of cultural identity in the emergence of the Minoanisation phenomenon is 'technical identity' (in Olivier Gosselain's term), shared and assimilated between artisans of that time. This is a more enduring facet of identity, transcending stylistic trends, and with arguably a more deeply embedded and lasting effect on the social lives of people. We might even suggest that this is perhaps the telling difference between Minoanisation and other -isations in the Bronze Age Aegean: the dissemination not just

determining acculturation and its end-product and alternative responses; on whether or not the Romans had a deliberate policy of 'Romanising' their subjects or if emulation is the main motor in order to assimilate, see [Woolf 1998](#), 22, fn. 74.

of novel practices and finished objects, but most crucially of technological know-how through the establishment and maintenance of *learning networks*, as a component of the intense interaction networks that shaped the Minoan world as we have come to know it. Given the above point that technical identity is often embedded and enduring, its mobility does then require explanation. It is as if mobility of identity is a new part of the Minoan identity in general in the Neopalatial period. One might say this is as true of Crete itself at this time as it is of the wider southern Aegean, and both on- and off-island it is hard to avoid the conclusion that the rise of Knossos as the dominant centre must be in some way responsible. As suggested above, it may be that the new interconnected network of objects in the Neopalatial period was promulgated largely by Knossos. However, with our approach we hope to have shown how this kind of conclusion can be generated from a multi-scale approach, rather than simply blanketed across the Aegean as a macro-scale explanation, itself incapable of accounting for the kinds of localised expressions and practices emergent within small-world networks.

8 | The Archaeological Signatures of Mobility: A Technological Look at ‘Aegeanising’ Pottery from the Northern Levant at the End of the 2nd Millennium BC

MARIE-CLAUDE BOILEAU

Abstract

This chapter offers a micro-scale perspective on the mobility of small groups of migrants and how these groups may be archaeologically visible in the already mixed material culture of the Late Bronze Age northern Levant. The fine-grained technological and analytical study of Aegean-type ceramics resulted in the identification of varied technological signatures and linking these to artisans of different cultural and geographical backgrounds.

Introduction

Mobility and interactions are an essential part of coastal areas, and the Levant is no exception, being located at the intersection of the east Mediterranean seascape and the Near Eastern landscape. Archaeological and textual records show that the intensity of the long-term interrelations and exchange networks between different powers and states peaked at the end of the Late Bronze Age (c.14th–12th centuries BC). The process of ‘Aegeanisation’ of the Levantine culture, which can be traced by the transmission and diffusion of different types of Aegean and Aegean-style pottery, follows a period of major transformations in the final centuries of the 2nd millennium BC. The transitional period of Late Bronze Age II–Iron Age I is marked by profound political and economic changes across the eastern Mediterranean, including the fall of the Mycenaean palatial system, migrations of people and the demise of the Hittite empire. The variegated local responses to this time of collapse and instability eventually led, at the beginning of the Iron Age, to the emergence of small independent states

This analytical study was conducted while the author was Williams Fellow in ceramic petrology at the Fitch Laboratory, British School at Athens.

whose material culture exhibits strong links with the Aegean (Harrison 2008; Yener 2013).

My intention here is to approach the 'Aegeanisation' process of the northern Levant from a methodological perspective with a focus on the manufacturing technology of Aegean-type pottery. Admittedly, I present a very narrow view on a highly complex process, aligning my focus with the aims of this volume to identify micro patterns of movement as evidenced by varied technological signatures (Chapter 1, this volume). There are two main reasons for this. First, as I have only recently been involved in analysing the Aegean and Aegean-type pottery from Tell Kazel,¹ I will leave it to the specialists to debate the nature and wider impact of the 'Aegeanisation' of the Levant. Second, my main interest in ceramic studies of Bronze and Iron Age material has been to identify different yet contemporary technological systems involving production at local and regional levels (Boileau 2005). My contribution to the topic of 'Aegeanisation' is, therefore, on how fine-grained technological and analytical methodologies can not only distinguish between imports, local imitations and 'mixed' types (i.e. Syrian vessels with 'borrowed' Aegean features) but, more importantly, link each of these ceramic types to artisans of different cultural and geographical backgrounds. It offers a micro-scale perspective on the mobility of small groups of migrants, which include artisans, specifically potters, and how these groups may be archaeologically visible in an already mixed material culture. To illustrate my point, I will use the published analysis of the Tell Kazel (Syria) Aegean and Aegean-type pottery, which resulted in the identification of foreigners among the local population (Badre et al. 2005; Boileau et al. 2010; Jung 2011a).

The 'Aegeanisation' Process of the Levant

The 'Aegeanisation' phenomenon of the east Mediterranean, and the nature of the destruction of many sites, is not as well understood for the northern Levant as it is for the southern Levant and Cyprus (see papers in Oren 2000). However, recent archaeological excavations of Iron Age I contexts in Syria and southern Anatolia (e.g. Cilicia), in combination with new radiocarbon dating and growing epigraphic evidence, attest to stronger links with the

¹ I am deeply grateful to Leila Badre and Reinhard Jung for giving me the opportunity to conduct petrographic analysis on the Tell Kazel Aegean, Aegean-type and Handmade Burnished Ware ceramics. I am however responsible for any misinterpretation.

Aegean than were previously assumed (see papers in [Harrison 2008](#)). But the presence of Aegeanised pottery in the Iron Age I Levant should not be equated with a process of transformation whose unique source is the Aegean. Instead, the collapse of the Late Bronze Age city-based, palace-centred economies should be seen as a complex period of crisis with varying effects on the northern Levantine coastal and inland settlements, and whose agents of change were not only coming from the west, but were also internal and regional (see [Bunnens 2000](#); [Klengel 2000](#); and papers in [Yener 2013](#)). The material culture of many Early Iron Age sites has strong Syro-Anatolian components along with Aegean elements and this 'plurality' appears to vary greatly from one site to the other. There is also a strong case to be made for continuity. Despite the destruction of many sites, local traditions continued in reoccupied settlements and became strongly regionalised in the Early Iron Age (see papers in [Bunnens 2000](#)).

As elsewhere in the East Mediterranean, 'Aegeanisation' is not a homogeneous phenomenon, reflecting instead regionally specific contacts of different intensity with the Aegean as evidenced by various patterns of reception, adoption and transfer of Aegean goods and practices ([van Wijngaarden 2002](#); [2007](#)). But beyond the Aegean/Aegeanising objects, easily identified in local assemblages, is the problem of identifying the presence of foreigners, i.e. migrants, who produced and consumed such objects. In the southern Levant, the presence of newcomers has been suggested not only on the basis of the urban transformations seen in the architecture and the textual evidence of the invasion of Sea Peoples, but also on the complete break with previous pottery traditions in terms of clay paste recipes and better use of the fast wheel, among other features ([Killebrew 2000](#); [2008](#)). Who exactly these people were is still a matter of debate with respect to their geographical origin, their intentions and the size of their groups. Were they all coming from the Aegean or could some groups originate from Cyprus, Cilicia or, even, the northern Levant? Should we see this mobility as a result of migrations of people from the broader Aegean, who left their homelands seeking a 'better' life or exploiting an economic opportunity left by the collapse of the palatial system, or is the 'Aegeanisation' of the Levant the result of a gradual and endogenous process, in which emulation and assimilation of Aegean culture played an important role ([Killebrew 2008](#))? The different viewpoints are not exclusive and the 'Aegeanisation' of the southern Levant, as it is for Cyprus and the northern Levant, is a phenomenon that is better understood through different processes taking place over centuries, rather than through a single explanation within a limited time-frame.

The Archaeological Signature of Immigrant Artisans

The question at hand here is how do we recognise the presence of small foreign groups of people – migrants – settling along the northern Levantine coast during this period of intense contacts and interactions?² How can we distinguish local imitations and mixed-types from the local products of newly settled artisans? Other contributions in this book discuss how the presence of new technologies in a landscape, such as wheel-making, attests to the presence of non-local artisans well versed in those techniques (Chapter 7 and Chapter 9, this volume). Indeed, with regards to the potting craft, forming techniques, such as wheel-fashioning or wheel-throwing,³ need a long apprenticeship and direct interaction between potters in order to be transmitted. However, in the Levant (as well as in the Aegean and Mesopotamia), as opposed to the central Mediterranean, for example, where wheel-making was introduced by Mycenaeans (Vagnetti and Jones 1988; Jones et al. 2005), wheel-making has been in use since the end of the 5th millennium BC (Roux 2008) and therefore cannot be used as a technological criterion for the identification of non-local potters.

Technological Variability in the Manufacturing Sequence

Equating people with pots has always been a major concern in archaeology, and particularly in the case of the 'Aegeanisation' process, with Mycenaean pottery in the east Mediterranean having been associated with large-scale migrations and colonisation (e.g. in Cyprus, Karageorghis 2000; but see Voskos and Knapp 2008 for a hybridisation perspective). However, a technological approach following the *chaîne opératoire* framework can positively contribute to wider research on identity and mobility. The detailed reconstruction of each step of the manufacturing sequence, often achieved by fine-grained analytical and morpho-stylistic analyses, leads to isolating specific technological variants which characterise different potting traditions and can even distinguish products of different potting communities active at a given settlement (Boileau 2005). Without such an approach emphasising variability, we run the risk of generalising interactions and misinterpreting the varied histories of a site.

² My discussion is not concerned with specialised itinerant craftsmen moving from one place to the other according to demand.

³ Wheel-fashioning uses rotational kinetic energy (RKE) on a roughout of assembled elements (e.g. coils), while wheel-throwing uses RKE on homogeneous mass (e.g. lump) (Roux 1994).

Challenging as it is, seeking out the social meanings of technological variability is about acknowledging the dynamic nature of potting activities and linking patterns in the material culture to social constructs. Pottery variability is created by the potters' physical and social environment as well as actions, choices and constraints with regards to raw materials, tools, methods of manufacture, finishing treatments, fuel and firing (Lemonnier 1993; Mahias 1993). But variability also finds its origin in the learning networks and transmission of skills and know-how within the communities of practice. As such, variability is linked to apprenticeship and the different levels of skills it generates in finished products (Coy 1989; Wallaert-Pêtre 2001; Wallaert 2008), to the products of different potting communities engaged in production at a local or regional level (Gosselain 2000; 2002), and to the process of reproduction, transformation and change inherent to any community of practice (Lave and Wenger 1991; Wenger 1998).

The focus here rests on (1) isolating the material markers of mobility – those technological variants which can tell us that people moved then settled in different places, (2) the social identity of the artisans and (3) their original geographical background. The methodology adopted is strongly influenced by the *chaîne opératoire* concept (Mauss 1935; Leroi-Gourhan 1971; Balfet 1991; Cresswell 1996; see Schiffer and Skibo 1987; Schiffer 2011 for behavioural chain analysis, a similar framework). The *chaîne opératoire*, i.e. production sequence of manufacture, is the empirical observation of the technical gestures, energy, tools and raw materials used in a sequence of interrelated operations and choices (Cresswell 1996, 43). The *chaîne opératoire* makes it possible to see technological differences in the manufacturing process, allowing us to identify a diversity of makers by their different choices and actions within the socially accepted and reproduced way of making a particular pot. At a broader cultural level, technological variability is about the changing relations between technique and society, how material production mediates social reproduction (Lemonnier 1992).

Not all steps of the *chaîne opératoire* however reveal the same facets of identity. The most visual aspects of pots – their shape and style – can be imitated and borrowed by any skilled potter. It thus represents a more superficial interaction, one that is rather linked with the consumer group and how the use of such pots reflects their social status and relationships with other people. On the other hand, the almost non-visible forming techniques represent a stable, inherited aspect of potting, one that is closely linked to apprenticeship and therefore rooted in the social identity of the potter (Gosselain 2002; 2011). The transmission of potting techniques requires direct interaction between potters, so for techniques to be transferred and

learned in a different cultural and geographical environment, potters must move as well.

Micro-Scale Approach: Aegean and Aegean-Style Wares from Tell Kazel (Syria)

The Late Bronze Age II–Iron Age I ceramic assemblage of Tell Kazel provides an excellent case study for the identification and understanding of mobility and identity as Aegean and Aegean-style pottery abounds alongside local traditions (Badre 2006). The archaeological site of Tell Kazel, situated in the northern Akkar Plain, is strategically located on the main passage between the Mediterranean coast and inland Syria, at the unique break point between the mountain chains of Mt Lebanon and Jebel Ansariyeh. Ongoing excavations at the site in Area II and Area IV (Badre et al. 1990; 1994; Badre and Gubel 1999–2000; Capet 2003; Badre 2006) have brought to light an extensive habitation quarter and temple complex. In the Late Bronze II levels – c. late 14th century until the beginning of the 12th century BC – the high frequency of prestige items and Cypriot and Mycenaean imports (with over 4,000 Cypriot and Aegean sherds, Capet 2008, 187) at the Temple complex and in the large residential area reflects a wealthy city engaged in external relations with the east Mediterranean. This phase ended with a brief period of abandonment without signs of destruction. In the transitional Late Bronze II–Iron Age I period which follows (c.12th century BC), the city is reoccupied shortly by what appears to be the same population (as evidenced by the continuity in material culture) reusing the temple and by newcomers integrated into the local community (Badre 2006). The period is almost completely devoid of imported material from the West. The pottery assemblage of that level is composed of Late Bronze Levantine wares but while Cypriot and Mycenaean imports are almost completely absent, locally produced pots of Mycenaean types and pots with mixed Syrian and Aegean traits are found in considerable quantities (Jung 2007). Along with these, a number of Handmade Burnished Ware pots appear at the site. Despite the fact that this period ended in a violent destruction by fire of the city, c.1179–1175 BC, the site was only abandoned temporarily. In the Early Iron Age, local architectural and ceramic traditions continue, but on a different scale, where large Late Bronze residential complexes were replaced by smaller dwellings (Capet and Gubel 2000).

Regarding the ceramics of the Late Bronze Age II–Early Iron Age I transitional period, questions arise as to who produced these Aegean-style

wares: local potters already well versed in wheel-manufacture technologies catering to the tastes of the local urban population? Or Aegean potters active in the Akkar plain producing pottery according to their traditional ways? Related questions deal with the identity of the consumers: were they newcomers at the site using a familiar repertoire, linked to specific food ways and customs? Or instead locals accustomed to Aegean pottery and incorporating new styles into their material culture, and perhaps reflecting changes in their consumption patterns?

Providing answers to the questions raised by the historical interpretation of the site, the analytical studies of the Kazel Aegean pottery aimed to firmly establish its provenance and fill a gap in our knowledge of the presumably locally produced Aegean-type vessels, including Handmade Burnished Ware (Badre et al. 2005; Boileau et al. 2010).⁴ In effect, the geochemical (acquired by NAA) and petrographic results demonstrated that the Mycenaean pottery imported at Tell Kazel was coming from the Argolid, namely from workshops in the region of Mycenae. With regard to those pots closely similar to the Mycenaean style, the analytical results confirmed a production local to Kazel and this is also true for the pots exhibiting mixed Mycenaean and Syrian features (Badre et al. 2005) and the majority of the Handmade Burnished Wares (Boileau et al. 2010).

Regarding the producers of the vessel types with mixed Mycenaean and Syrian features, there is no reason not to see Syrian potters making these mixed wares. In this case, no transfer of technology for the manufacture of these vessels was required since local potters were already well skilled in wheel-making technologies for vessels of different sizes and forms. They also had the advantage, over newcomers, of the knowledge of the location of clay sources in the Akkar plain, in addition to the necessary clay selection, processing and manipulation and kiln firings needed for thin-walled, wheel-made, well-fired vessels. As mentioned previously, petrographic analysis confirmed that the clays were locally sourced but it also showed that the fabrics of these mixed pots were somewhat coarser grained than the contemporary Greek ones and as such are comparable to the fabrics of the Syrian products. Of course, there is always the possibility that potters trained elsewhere in the Aegean had been active at Kazel for some time – enough to acquire the appropriate knowledge of the clays and modify their performances to include such changes in the production sequence – but there is really no reason to exclude the local specialised potting communities

⁴ Complete analytical results have been published in Badre et al. 2005 and Boileau et al. 2010 and only a selection of the data is commented on in this chapter.

as the producers. As the initial study was essentially interested in sourcing the clay pastes, a detailed reconstruction of the *chaîne opératoire* of these mixed vessels as well as of the Syrian vessels, with an emphasis on the forming techniques and surface treatments, is definitely needed before correctly identifying the origin of these potters. What is clear however is that the breakdown of the trade networks with Mycenaean Greece, halting almost all imports at the site, created some sort of a void in the demand of the consumer group. These mixed vessels seem to have filled this need. However as they exhibit both local and borrowed traits, they are not merely a substitution product but instead probably attest to changes in the local systems of expression and consumption practices, possibly as communities of mixed groups do to negotiate their identity and social relationships.

In comparison to the locally produced Aegean-types, Handmade Burnished Ware⁵ (hereon HMBW) stands in sharp contrast. HMBW is a coarse utilitarian type of dark pottery which appears at the end of the 2nd millennium BC in small quantity on a number of sites in the Aegean, Anatolia and the Levant. Because of its distinct techno-morphological characteristics, scarce quantity, context and specific chronological situation, HMBW is seen as an intrusive element and has been traditionally associated with newcomers (Ward and Joukowsky 1992; Oren 2000; Lis 2009; Chapter 10, this volume). In the Levant, Tell Kazel has yielded the most important assemblage of HMBW, higher even than the quantity of HMBW so far found in Greece and Cyprus (Bounni et al. 1979; Pilides 1994; Badre 2003; Capet 2008; Jung 2009a).

The raw materials used in the manufacture of most of the Tell Kazel HMBW are consistent with those observed in the local fabrics and clay/sediment samples collected in the vicinity of the site (Boileau et al. 2010, 1682–4), characterised by Quaternary deposits of alluvial material and outcrops of Pliocene Piacenzian marine deposits, with Pliocene alkali basalts outcropping more inland (Dubertret 1962; Ponikarov 1963; Beydoun 1977; Abdel-Rahman 2002; Abdel-Rahman and Nader 2002; Abdel-Rahman and Nassar 2004). Overall, HMBW pots exhibit a high percentage of long voids, a coarse-grained marly to argillaceous groundmass with poorly sorted marl clasts (micritic), chalk, basalt, alkali feldspar, plagioclase, chert, iron concentrations, quartz, carbonised plant remains, and grog in various amounts. The mineralogy of the main HMBW fabric is very similar to those of the locally produced Syrian vessels (Boileau et al. 2010) but the fabrics are coarser grained and have a higher degree of heterogeneity.

⁵ Previously known as 'Barbarian Ware'.

Beyond the distinct morpho-stylistic attributes of the HMBW, a combination of technological characteristics also make these vessels unique at the site; with the modes of production (cf. Costin 1991) attesting to a domestic, household-based production by non-specialist potters making pots, not for exchange, but for their own consumption. First, the clays are coarse-grained and tempered with poorly sorted temper, often a combination of plant, rock fragments and/or grog. There is no 'standard' recipe, apart from the need to acquire a coarsely textured paste. Sometimes the clays are not well kneaded together and many air bubbles remain trapped (i.e. there is high porosity) in the clay paste. Second, the vessels are manufactured, not on the fast wheel like the Syrian and locally produced Mycenaean pots, but entirely hand-made without any use of rotative movement, slow or fast. The actual handmade technique(s) have yet to be identified but the structural alignment of voids, elongated inclusions as seen in thin section along with the break pattern of the pots and sherds suggest that small slabs and/or large coils were used for the primary forming (i.e. roughouts made of assembled elements). Unfortunately, surface features diagnostic of specific techniques are rare and difficult to interpret because of the subsequent rough burnishing treatment. It would be quite interesting to verify if the heterogeneity of the clay preparation is also reflected in the forming process where different hand-making methods might have been used. Regarding surface treatment, the quality and orientation of the burnishing also display variation from one pot to the other. Finally, HMBW pots exhibit dark surfaces ranging from black to dark reddish brown. This variation in colour is also attested at the microscopic level and points to open firing techniques (i.e. bonfire) in mainly reducing but an uneven firing atmosphere. The optical activity of the micromass and the presence of carbonised plant remains as seen optically attest to relatively short firings at low temperatures. This firing technology is in contrast, again, with the local Syrian practices where pots are fired in kilns with a well-controlled oxidising atmosphere and resulting in evenly light coloured wares.

With the heterogeneity of the fabric, surface treatment and firing, as well as vessel shapes (see Badre 2003), as if each pot is uniquely made, one gets the impression of an ad hoc household-type non-specialised production. In short, the detailed reconstruction of each step of the HMBW *chaîne opératoire* highlights a ceramic tradition entirely different from the rest of the local assemblage. In addition, the presence of grog temper and open-fire practices are technological features not seen amongst any of the other local products. The contrast in technology between the local Syrian and Aegean-type wares on the one hand and the HMBW pots on the other hand is

striking and points to an intrusive character for the latter. Yet, the raw materials, as the petrographic study has shown, are consistent with the geology of the northern Akkar Plain. Interestingly, this analytical result is in line with clay analyses of HMBW found in Greece (Rutter 1990, 31; Jung 2006, 24 note 98) and Cyprus (Pilides and Boileau 2011; but see D'Agata et al. 2012 for a 'broadly' local production), which indicate that when HMBW pots were found in some quantity, they were locally manufactured using available raw materials. Moreover shapes are those used for storage, food preparation and consumption activities. As such, HMBW pots do not fill a gap in the local repertoire (Capet 2008) and are quite different shape-wise from those used for similar domestic daily-life activities.

It has been suggested that HMBW might have been a local response to the breakdown of the political and economic system, one that forced potters to revert to hand-making practices (Capet 2008, 205). It is true that, in the history of the Levant, wheel-fashioning appears and disappears a number of times since the 5th millennium BC when the fragile and isolated socio-economic contexts of production collapsed. However, wheel-making using the fast-wheel did become a fixed and robust system in the second half of the 2nd millennium BC (Roux 2008) and the Late Bronze–Iron Age transitional period still sees wheel-making being used for the majority of Levantine and mixed wares. In light of these results, the producers of HMBW in the Akkar Plain and living at Tell Kazel seemed to have been foreigners, newly settled at the site, manufacturing pots according to their own potting tradition and consumption practices.

Regarding the difficult question of the cultural origin of these groups, the key element here could be the grog tempering of many, but not all, of Tell Kazel HMBW pots. Grog tempering is not a technological feature attested so far in the other local and Aegean fabrics but has been already noted in some of the HMBW wares in mainland Greece (Whitbread 1992) and in some of the impasto pottery – a handmade burnished tradition – from several contemporary southern Italian sites of the Recent Bronze Age (Levi 1999, 133), to which the HMBW of Tell Kazel is linked in terms of its typology and technology (Bettelli 2002; Jung 2006; 2009a). From the perspective of the organisation of production in southern Italy, it appears the potters of the hand-making traditions were non-specialists and worked at the household level of organisation (Levi 1999; Loney 2007). The same type of organisation can be deduced from the Tell Kazel HMBW pots.

Overall, the stylistic, technological and analytical data support, so far, the hypothesis that HMBW, at least at Tell Kazel, is linked to the presence of mobile groups of foreigners, following the routes of Italo-Mycenaean

contact and exchange and establishing themselves in the Akkar Plain for a rather short period. If we are correct, it is interesting to note that hand-making is a technology very well suited to a mobile way of life. The reconstruction of the *chaîne opératoire* of the HMBW has already shown that potters used coarse clays, sometimes adding temper such as organics or grog, formed by hand various utilitarian containers and short-fired them in open firings. Interestingly, it is this very operational sequence that actually allows the HMBW potters to manufacture their containers in new and foreign landscapes where the sources of good potting clays are unknown, where kiln building requires investment of time, high output and in which heavy tools such as wheels might not be easily transportable.

There is another group of Aegean-style pottery which may indicate the presence of immigrants at Tell Kazel: the undecorated Mycenaean tableware. Found in the same transitional level in which the HMBW was excavated, this set of unpainted consumption vessels (for food and drink but also cooking) is so far represented by fewer than 100 vessels (Jung 2011a). Neutron activation and petrographic analyses have shown that these vessels were locally manufactured (Badre et al. 2005; Boileau et al. 2010) but Reinhard Jung explains in a recently published study that these vessels should not “be interpreted in terms of import substitution because the local Mycenaean pottery of Kazel exhibits a vessel repertory radically different from the range of shapes that were imported from the Aegean during the preceding phases” (Jung 2011a, 123). In other words, for local potters to borrow or imitate a set of vessels, they must be in the presence of the actual finished products, which is not the case here. Furthermore, petrographic data has shown that these pots were made with a much finer and more homogeneous fabric than the other locally manufactured Aegean and Syrian types (Badre et al. 2005). So clay selection and preparation was conducted differently from the contemporary production, the latter being coarser grained and exhibiting more fabric heterogeneity. In addition, the finishing surface treatment of wet-smoothing is similar to the contemporary Mycenaean production in mainland Greece (Jung 2011a, 128). With regards to the identity of the artisans producing this ‘specialised’ set of unpainted Mycenaean vessels at Kazel, Jung’s current working hypothesis is that they might have been immigrants from Greece, most probably from the less privileged classes of the fallen palace system, “who were used to these vessel shapes in their everyday lives” (2011a, 129).

Conclusion: Bridging Local Histories to Wider Regional Perspectives

In this chapter, I have tried to demonstrate how a micro-scale perspective on the 'Aegeanised' process of the northern Levant, focused on technological variants evidenced by a *chaîne opératoire* approach, permitted the social identification of different groups of migrants producing and consuming specific ceramic repertoires. Both unpainted Mycenaean and HMBW pottery point to the presence of small group of foreigners with cultural ties to mainland Greece and South Italy, settling, at least for a short time, at Tell Kazel. These results, even if demonstrated at the micro-scale perspective, can be linked to the wider phenomena of mobility characteristic of the end of the 2nd millennium BC. What is further needed for a better comprehension of the process, to bridge the finer data to wider phenomena, is a meso-scale approach that would look at other sites in or near the Akkar Plain. An intra-regional perspective would certainly yield a variety of interaction networks and perhaps lead to the identification of migrants whose cultural and geographical origins differ from those so far identified at Tell Kazel.

The results discussed here show that, in order to address the challenging question of the artisans' socio-cultural identity, multiple datasets – contextual, stylistic and analytical – are necessary to reconstruct and interpret the full production sequence. The *chaîne opératoire*, allowing for a closer examination of the potters' choices, know-how and skills at each stage of the production sequence, make it possible to distinguish, among a mixed assemblage, the products of artisans belonging to different technological traditions. In the case of the unpainted Mycenaean vessel, knowledge of how such vessels were produced and used in their original geographical and cultural context was equally important. In sum, the results point to the fact that different types of Aegean and 'Aegeanising' pottery need different historical explanations, thus adding to the overall complexity of the 'Aegeanising' process in the northern Levantine material culture, one that is definitely characterised by multiple trajectories and various archaeological signatures of mobility.

9 | Mycenaean and Mycenaeanising Pottery across the Mediterranean: A Multi-Scalar Approach to Technological Mobility, Transmission and Appropriation

EVANGELIA KIRIATZI AND STELIOS ANDREOU

Abstract

Although mobility and connectivity comprise major parameters of Mediterranean life, it is not until the 2nd millennium BC that the Middle Sea actually became a connecting sea. The appearance of Mycenaean-style objects, predominantly pottery, in a growing number of sites in the eastern and central Mediterranean comprises some of the earliest and much discussed related evidence. To provide thoughtful insights into this multifaceted phenomenon, this chapter revisits the meaning and social life of these objects through an approach to human mobility that is multi-scalar and technology-based, putting emphasis on the study of technological practice, transmission and appropriation.

Introduction

Mobility and connectivity have been major aspects of Mediterranean life, throughout its history (Horden and Purcell 2000; Braudel 2001) and prehistory (Blake and Knapp 2005; Broodbank 2013). It is not, however, until the 2nd millennium BC that the Middle Sea actually became a connecting sea. For the first time, distant places seemed to be regularly connected, and links developed between the east and west Mediterranean (Figure 9.1). Long-distance travel across the sea, but also over land, was established for the first time as a recurrent phenomenon due to both technological achievements and socio-economic and political conditions (Chapter 2, this volume). The emergence of highly centralised administrative and political centres across the east Mediterranean was associated with unprecedented requirements for raw materials and craft products to consolidate the elite power and redistribution of staples within each regional system, and to secure



Figure 9.1 Map of the Mediterranean with locations mentioned in the text (drawn by Nikos Valasiadis).

the inclusion of the elite in complex webs of inter-regional alliances. This desire for new resources, unparalleled so far in intensity and scale, gave rise to extensive networks along which goods and people and also technologies and lifestyles moved (Sherratt and Sherratt 1991; for references, see Broodbank 2013). For the first time, connections were established not only between the east of the basin and places in the central and subsequently west Mediterranean (Blake 2008; Iacono 2012), but also in central and northern Europe (Jung 2006; Kristiansen and Larsson 2005; Chapter 10, this volume). At a much larger scale and more frequently than ever before, a section of the population (e.g. seamen, merchants, craftspeople, possibly mercenaries, etc.) had direct exposure to distant cultures, and contact with people who spoke (or even wrote) a different language, dressed in a different way, followed different lifestyles and worldviews. Within such a context, different kinds of mobility took place, with diverse motivations at the individual and collective level. New means of communication emerged, such as commonly accepted systems of value to facilitate exchange and trade (Bevan 2007), and common practices and related types of material culture were developed to make possible intercultural associations, and, of course, the mutual understanding of languages and scripts. Yet, mobility was far

from the norm for the greater part of the population that continued to cultivate the land, keep animals and raise children. However, for some or most of those not involved in long-distance mobility, indirect exposure to new lifestyles, especially through objects, became a more or less frequent phenomenon. The most straightforward indication for these new conditions is the broad distribution across large areas of the Mediterranean of certain types of material culture. The encounter with Mycenaean-style objects, predominantly pottery, in a growing number of sites in the eastern and central Mediterranean comprises some of the earliest and much discussed of such evidence (Sherratt 1999; van Wijngaarden 2002; Manning and Hulin 2005; Broodbank 2013). The widely attested Mycenaean pottery (a phenomenon not unrelated to its durability and distinctiveness) has been the focus of a large number of studies concerning inter-regional mobility and intercultural interaction in the Mediterranean during the second half of the 2nd millennium BC. To provide thoughtful insights into this multifaceted phenomenon, this chapter revisits the meaning and social life of these objects through an approach to human mobility that is multi-scalar and technology-based, putting emphasis on the study of technological practice, transmission and appropriation (cf. Chapter 1, this volume).

Setting the Agenda

The wide distribution of Mycenaean-style material culture, predominantly pottery, often considered as a reflection of 'Mycenaeanisation' (Vanschoonwinkel 2006), has been traditionally associated with trade/exchange, emulation, migration and/or colonisation processes. Such explanations have usually been advocated in the context of two, not always distinct approaches: (1) as a result of an acculturation process involving a high/donor and several lower/recipient cultures (Kantor 1947), (2) as the outcome of interactions between a core area and a periphery (Kilian 1990). A common weakness of both approaches, however, is the relatively passive role afforded to the peripheries as instinctive and welcoming recipients of anything the active core can offer. Such approaches usually consider a unidirectional flow of influences from the core/donor societies to the peripheries/recipient cultures and put emphasis on external dynamics of change (Stein 2002). Despite these limitations, an obvious advantage of the more sophisticated versions of core-periphery approaches is that they have provided a wider perspective and emphasised the need to break down the traditional narrow boundaries of regional archaeologies (Sherratt and

Sherratt 1991; Sherratt 2009). On the other hand, the emphasis on the study of the wide picture has often discouraged the study of each case separately, hampering the understanding of the specific context of each instance of inter-regional interaction. More recently, partly under the influence of post-colonial theory and discussions regarding agency, researchers have begun to examine the active role of local agents in processes related to the adoption of Mycenaean cultural elements in various regions of the Aegean and the Mediterranean (Vagnetti 1999; Andreou 2003; Blake 2008; Jung 2011b; Iacono 2013; Jones et al. 2013; papers in Gorogianni et al. 2016). As a result, the investigation of hybridisation processes has gained some popularity in recent years. So far, however, the discussion remains descriptive since it fails to examine the phenomenon in the social context of its creation (Knapp 2008; Voskos and Knapp 2008; Stockhammer 2012b).

Overall, in most cases, the study of the so-called Mycenaean cultural expansion is based on typological study of pottery, combined sometimes with compositional characterisation, for the identification of imported vs. locally produced pots, and subsequently the differentiation of the so-called local imitations or hybrids (for critical discussions on the use of such terms, see Papadopoulos 1997; van Wijngaarden 2002). However, even the basic categorisation of local vs. imported artefacts is not without inherent problems, especially when the aim is to understand how these artefacts were perceived by the consumer(s).¹ Did they conceive them as local and familiar, or foreign and exotic? Objects move across space either together with their owner (so presumably keeping their original meaning and role although potentially adjusted to the new consumption context) or from one owner to another, in the process losing their original meaning, either partly or completely, depending on the kind of interaction between the old and new owner (Thomas 1991; Bevan 2007). Moreover, the widely used term *imitation* masks a wide variety of attitudes, ranging from copying single morphological characteristics just by looking at something, to the reproduction of the whole *chaîne opératoire* of an object's manufacture that reflects transmission and/or appropriation of socially situated knowledge (Lave and Wenger 1991; Gosselain 2011). The same applies to the so-called hybrids or derivatives, as borrowing or mixing of different elements (e.g. decoration patterns vs. forming techniques) would reflect different types of contact between craftspeople of distinct traditions. These different attitudes

¹ The perplexities of this approach and the confusion that it is related to, or that it produces, are evident in the discussions concerning the classification of decorated wheelmade pottery in Cyprus (Cadogan 1993; Kling 2000).

reflect very different interaction and mobility patterns, concerning both people and objects, and are associated with distinct processes of technological transmission and appropriation (Gosselain 2000; 2008; 2011). Similar questions apply to the way such objects were used, i.e. were they used in the context of 'new' or pre-existing practices (cf. Thomas 1991)?

Based on the above, our current approach is characterised by:

- i. the combination of top-down and bottom-up perspectives bringing together the site, regional and supra-regional (Mediterranean) levels. The aim is, on the one hand, to study local phenomena both in their own context and within broader social and geographical frameworks and, on the other, to understand the effect of global phenomena at a local level.
- ii. an emphasis on the study of technology and the social context of its transmission and appropriation. This is accomplished through the study of case-by-case coexisting potting traditions (local and Mycenaean ones) and their interrelation mainly in terms of horizontal (across space/groups) and vertical (through time/across generations) transmission and appropriation of technological knowledge/practice.

The Top-Down Perspective

During the 17th to 15th centuries BC (Late Helladic [LH] I–II), small-scale centres of power developed in the Greek mainland competing for resources, territorial control and status (Wright 2008). By the 14th to the 13th centuries BC (LH IIIA and B), the most successful developed into what many scholars consider as proper states, i.e. political structures administered from central places of power, usually referred to as 'palaces'. Elaborate water management systems secured agricultural production, which was selectively controlled by the ruling groups, while ports, roads and bridges facilitated movement. Craft production was also selectively administered by the ruling elites in order to satisfy specialised needs for export and feasting (Voutsaki and Killen 2001; see relevant chapters in Shelmardine 2008 and Cline 2010). The core areas of Mycenaean culture extended from central Greece to the Peloponnese (Figure 9.1) and the so-called Mycenaean koine culture encompassed all aspects of life from the inhabited landscape to the production of standardised pottery wares and the prominence of a feasting lifestyle (Bennet and Davis 1999; Wright 2004; Feuer 2011). Nevertheless, palace-centred states were not universal across this region, and a certain amount of local variation

in social practices and material culture can be discerned. Overseas contacts for the establishment of alliances and the acquisition of raw materials and exotica were crucial in the emergence, establishment and reproduction of the Mycenaean elites, although their extent and nature remains unclear and invisible in contemporary written records (Sherratt 2001).

The so-called Mycenaean pottery reflects a dominant supra-regional tradition that developed mainly in the Peloponnese (NE or SE) from the amalgamation of elements of regional traditions, under strong original Cretan influence (Dickinson 1977; 1994). Despite regional variations, its overall manufacturing technology, vessel repertoire and decoration are highly standardised (Furumark 1972; Mountjoy 1986; 1993; 1999). Its production reflects a common basic *chaîne opératoire*: clay pastes were generally prepared with refined calcareous clays; vessels were formed with the use of the potter's wheel;² surfaces were usually smoothed or polished and painted decoration was sometimes applied with the use of iron-rich paints; pots were fired in up-draft kilns either in oxidising or alternating oxidising-reducing-oxidising controlled conditions. The standard pottery assemblage of a Mycenaean site included painted, but mostly unpainted, tableware, as well as cooking and storage pots in coarser, even non-calcareous fabrics.

The overall silence of the Linear B archives concerning pottery, with rare exceptions, has been considered to reflect the limited and rather selective interest of the palaces in controlling pottery production, basically in order to secure supplies for their own feasting, and possibly industrial, activities and for containers of aromatics and oils mostly destined for exchange (Palaima 1997; Knappett 2001; Whitelaw 2001; Galaty 2010). Potters do not seem to have been either members of the palace personnel or administered craftsmen, working exclusively for the ruling elites, although they had to supply the palaces with pottery for their own needs that could be rather easily satisfied by a small number of producers (see Whitelaw 2001, although probably inflated figures). The investment in high-tech technology (know-how of potter's wheel and kiln firing) and relevant facilities, the standardisation of the products and the assumed large scale of production, all seem to indicate a highly specialised activity and a workshop model of production. Moreover, there seems to be limited and rather inconclusive evidence that Mycenaean pottery manufacture was probably a male activity (Hruby 2007; 2011).

² As a rule, Mycenaean vessels are considered wheelmade, that is manufactured through the use of a rotating device and the application of rotational kinetic energy (Courty and Roux 1995; Roux and Courty 1998; Roux 2003), without any targeted technological study yet to explore the use of wheel-throwing or wheel-coiling techniques.

Looking at the Mycenaean pottery abroad, one can see general trends and local variations. During the pre-palatial period (LH I–II), a small number of such pots occasionally find their way to a limited number of coastal sites in the Aegean, the central and eastern Mediterranean (usually in areas with some connection to metal resources, e.g. Chalcidice, Aeolian islands and Tyrrhenian coast, Cyprus, etc.) (van Wijngaarden 2002; Blake 2008). This is the period of exploration and networking abroad aiming to expand access to resources, exotica and alliances. Small numbers of pots produced in the core areas of the Mycenaean world probably travelled together with seamen, merchants or elite representatives and reached local communities in the context of sporadic, non-systematic (gift?) exchange. In the subsequent palatial phase (LH IIIA–B), the distribution of such pottery became wider and its frequency rose, while local production is attested in a number of locations outside the Mycenaean heartland (Mountjoy 1999; van Wijngaarden 2002). The frequency and the repertoire of the Mycenaean pots occurring in each area, as well as the development of local production in each case, vary significantly even among sites in the same region (van Wijngaarden 2002), for specific examples see Steel 1998 (Cyprus); Steel 2002 (Syro-Palestinian coast); Bell 2005; Iacono 2013 (Italy).

During this period, Mycenaean pottery production must have increased overall, aimed at fulfilling growing needs at home, as well as trade and exportation at regional and supra-regional levels. One could assume that, given the prevailing appropriate socio-economic conditions, once the relevant technology was mastered, the demand for large-scale production encouraged the emergence of organised production units (workshops?) functioning at an extended household level or even beyond that, in the context of an (almost or seasonally) full-time activity (cf. Whitelaw 2001). There seems to have been an overall change in the potting industry, one that also would reflect the involvement of a larger group of individuals in subsidiary activities. Moreover, the development of a supra-regional Mycenaean pottery style (in terms of vessel forms, decoration, as well as technology; for technological style, see Lechtman 1977) could also reflect changes in the learning and transmission of the craft, and one could presume that apprenticeship might not take place mainly or exclusively in the family context, especially if potting became mainly a male activity. This would match the assumption of mobile, rather entrepreneurial, potters encouraged by a rising demand for Mycenaean-style vessels, under socio-political conditions that support and even promote long-distance travel and intercultural interaction. Although the emphasis on pottery production seems to vary among different regions or even palace states (e.g. based

on current evidence, more emphasis on pottery export and production of specialised types of pictorial pottery in the northeast Peloponnese and less so in Messenia, Boeotia or Laconia (Mommesen and Maran 2000–1)), it becomes obvious that Mycenaean pottery was not an elite commodity involved in high-level gift exchange. It has been argued persuasively that alongside the highly centralised, elite gift exchange, a new type of exchange developed, which was non-administered, opportunistic and diversified, associated with low-value and high-bulk craft products, among which pottery occupied a prominent position (Sherratt 1999). Within such a context, one could argue about the existence of travelling craftspeople, administered or freelance (Zaccagnini 1983; Cline 1995; Papadopoulos 1997).³ This technological mobility, together with the circulation and use of the final products, obviously contributed to the wider dissemination of lifestyles (as well as of cultural and social values) and to the development of a more commercial type of exchange and a mass market, which eventually may have undermined the highly centralised gift exchange which was administered by the elites and, according to Sherratt, could have contributed to the collapse of the palatial system (Sherratt 1999; 2001).

In the post-palatial era (LH IIIC), exportation of Mycenaean pottery decreased dramatically to sites in the east and central Mediterranean. Nevertheless, local production in these areas continued, or even increased, probably concentrated at a number of places in the central and eastern Mediterranean, as well as in the northern and eastern Aegean. This suggests that, while intercultural interactions remained strong, their character and mechanisms had changed. Large-scale production in Mycenaean centres aiming at exportation decreased, as a consequence of the collapse of the palaces; but mobility of potters increased, parallel to the exploration of new markets and new opportunities. In many regions of the Aegean and the Mediterranean, Mycenaean or Mycenaeanising pottery had acquired an established role in local societies and continued to be produced either by Mycenaean potters, their locally settled offspring, or trainees. It is during this period that distinct regional styles developed. Eventually, however, where local conditions did not encourage a continuing demand for such pottery and/or its production, the extent of the interaction networks diminished and both importation and local production of Mycenaean pottery came to an end.

³ See comments by Bass about evidence of travelling craftsmen in the Gelidonya ship during the post-palatial period (Bass 1967).

The Bottom-Up Perspective

Looking at the context of consumption and local production of Mycenaean pottery, in order to understand its role and meaning for the indigenous communities, it is necessary to compare it with the products of local potting traditions in each context, not only in terms of function but mainly in terms of technology and conditions of manufacture. Given that Mycenaean pottery, imported or locally produced, shows a wide distribution across the Mediterranean, it is important to stress that the pre-existing local potting traditions, in each case, varied significantly. Overall, and rather simplistically, two distinct types of local potting traditions can be discerned in the mid-2nd millennium BC around the central and eastern Mediterranean: the handmade pottery traditions and those using the potter's wheel. One can take further this crude distinction and associate the two types of potting traditions with different models of production and social organisation. The handmade pottery traditions, mainly in the west and north, tend to relate to production models usually associated with the family/household in the context of less complex socio-political systems, while the wheel-using pottery traditions tend to occur in more highly specialised production models, such as workshops (Roux and Corbetta 1989; Costin 1991), centrally administered or not, in the context of more complex socio-political systems, mainly in the east Mediterranean. Of course, the coexistence of handmade and wheel-using pottery traditions on Cyprus (Crewe 2007) indicates that such divisions are not that clear-cut and alerts us to the simplistic nature of such a dichotomy. As the focus of the current study rests on the interaction between different potting traditions, it is clear that the more distinct the traditions (and the associated production models), the easier it will be to compare and investigate the influence of one tradition on the other. For this reason, and in order to illustrate more effectively the potential of the current approach, the emphasis here will be mainly on areas where local traditions and production models are very distinct from those of Mycenaean pottery, with a brief discussion of the cases where local and Mycenaean potting traditions are not so dissimilar, usually in more complex socio-political contexts. Admittedly this situation has already influenced relevant research as studies concentrate mainly on technological and production aspects in the former case (e.g. central Mediterranean), and more on typological/morphological aspects and the consumption context in the latter case (e.g. Cyprus, the Levant and Egypt).

The case studies discussed in this chapter concern central Macedonia in its wider context and, to a lesser extent, the central Mediterranean, while

comparable cases from the eastern Aegean and eastern Mediterranean will be only briefly commented upon at the end.

Central Macedonia

The Bronze Age landscape of central Macedonia is dominated by tells (archaeological mounds). During the Late Bronze Age their number increased considerably, and inequalities emerged between the sites in the various subregions of the area. These inequalities are evident through inter-site differences in terms of size, height, storage capacity, scale of surrounding retaining terraces or ramparts etc. The extent to which they may reflect the rise of hierarchical social relations at the regional level remains unclear. On the other hand, recent evidence indicates that social changes were also taking place during the same period in other regions of Macedonia following different trajectories. The incidence of few rich and elaborate cemeteries at certain strategically located inland communities in western, southern and eastern Macedonia may signify the rise of elite groups, which based their power on their military strength and their ability to control communications and the circulation of small-volume/high-value goods. It is in this context that the Mycenaean pottery appeared in Macedonia (Andreou 2010). Considerable changes and variation are evident in the frequency and the chronological and spatial distribution of such pots. The process has been studied more systematically in central Macedonia and can be conveniently separated into three chronological phases.

During the first phase covering the 16th to early 14th centuries BC (LH I–LH III A1), few early Mycenaean vessels were limited to sites in coastal Chalcidice, Pieria and the Thermaikos gulf (Andreou 2003; Haensel and Aslanis 2010; Poulaki-Pandermali et al. 2010) (Figure 9.2). The largest concentration has been found so far at the site of Toroni, on the tip of the almost insular Sithonia peninsula in Chalcidice. The region is rich in gold, silver and copper and remained connected to the communication networks of the Aegean throughout the Bronze Age. This earliest occurrence amounts to over a dozen sherds of finely decorated drinking cups and aromatic oil containers, which were presumably imported from the central or southern Greek mainland (Cambitoglou and Papadopoulos 1993; Morris 2009/10). During the same period, however, the local ceramic assemblage consisting of handmade monochrome and usually burnished pots (Figure 9.3: 1–3) was significantly enriched with the first appearance of two, also handmade, decorated wares, one matt-painted (Figure 9.3: 5–6) and the other incised

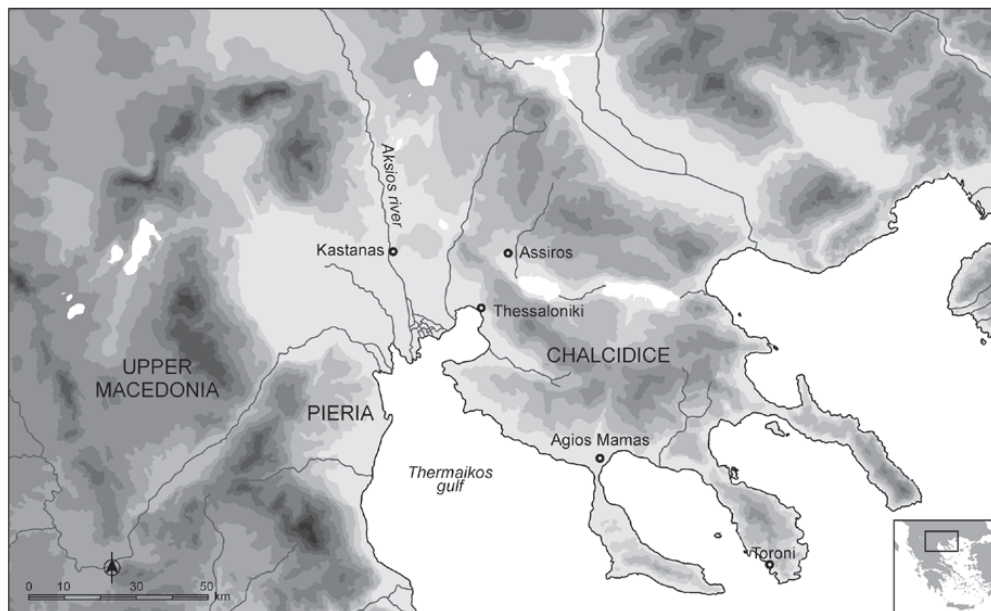


Figure 9.2 Map of central Macedonia with locations and sites mentioned in the text (drawn by Nikos Valasiadis).

and encrusted with white paste (Figure 9.3: 4). They both occurred in very limited numbers at several sites (Andreou and Psaraki 2007). The former comprises local vessel types intended for drinking and serving and reflects southern influences in terms of decoration (Horejs 2007), while the latter comprises primarily small narrow-mouthed jars known also in the central and eastern Balkans and, according to archaeological and recent chemical evidence, could have been used for aromatic oils or unguents (Andreou et al. 2013). This evidence suggests some interaction with areas both in the Balkans and the south Aegean. The painted and incised handmade vessels, however, are products of the local potting tradition, produced in limited amounts by a small number of potters who adopted decoration technologies from neighbouring areas in the north and south (Kiriati 2000). These decorated pots probably circulated among select individuals, marking their preferential access to certain social practices, associated with drinking and body cleansing, through which they promoted the creation of new social roles and identities within the local communities.

The second phase covers the 14th and 13th centuries BC (LH IIIA–IIIB). During this period the frequency of decorated Mycenaean pottery increased, although it still occurred in small numbers, not exceeding – even in centrally located sites such as Thessaloniki Toumba – 5 per cent of the total

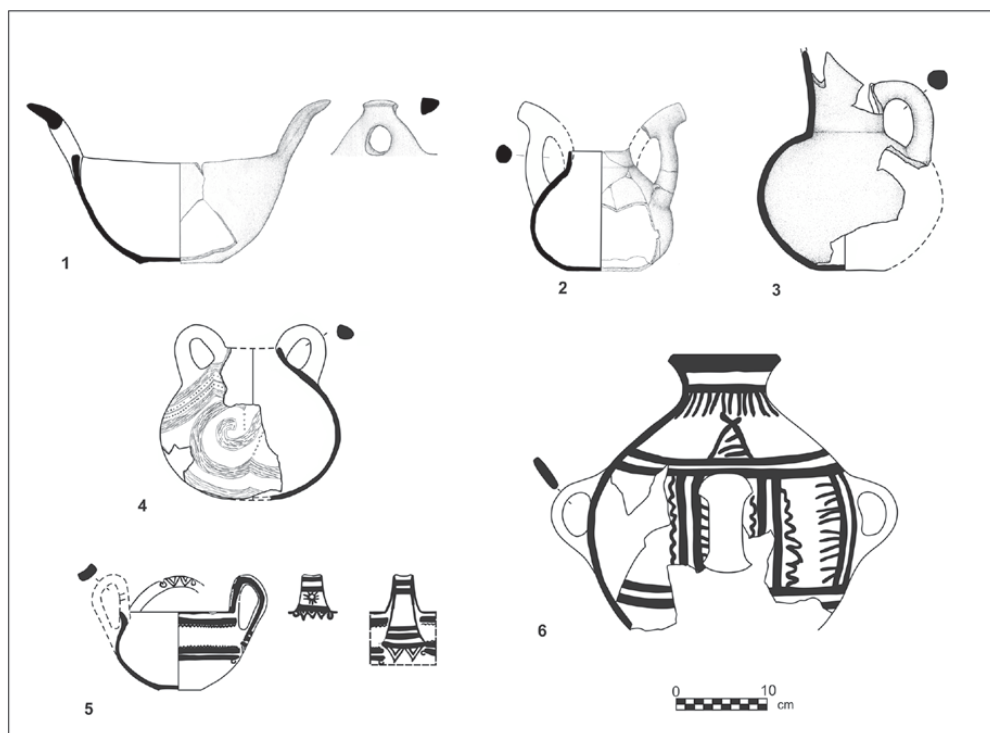


Figure 9.3 Common types of local handmade pottery in central Macedonia, all to same scale (courtesy of Thessaloniki Toumba excavations; designed by Nikos Valasiadis).

amount of tableware and a much smaller percentage of the whole pottery assemblage (Andreou 2003; Andreou and Psaraki 2007, fig. 3). The primarily imported vases are distributed more widely in the area than before and are found both in coastal and inland sites. This change coincided with the palatial Mycenaean period in south and central Greece and was probably related to the expansion of marine and land communication networks in the area with probably more frequent visits of Mycenaean boats at coastal sites of the northwestern Aegean. The visits, however, must have remained few and sporadic.

The rise in the number of Mycenaean vases coincided with the increased use of the elaborately decorated, matt-painted and encrusted vessels and presumably an increase in social occasions of drinking and the incidence of body treatment for which these pots were most likely employed. The Mycenaean vessels found in the area belong consistently to decorated shapes, which are appropriate primarily for the drinking and serving of liquids, most probably wine (deep bowls, stemmed bowls, kylikes, kraters, jars and jugs)

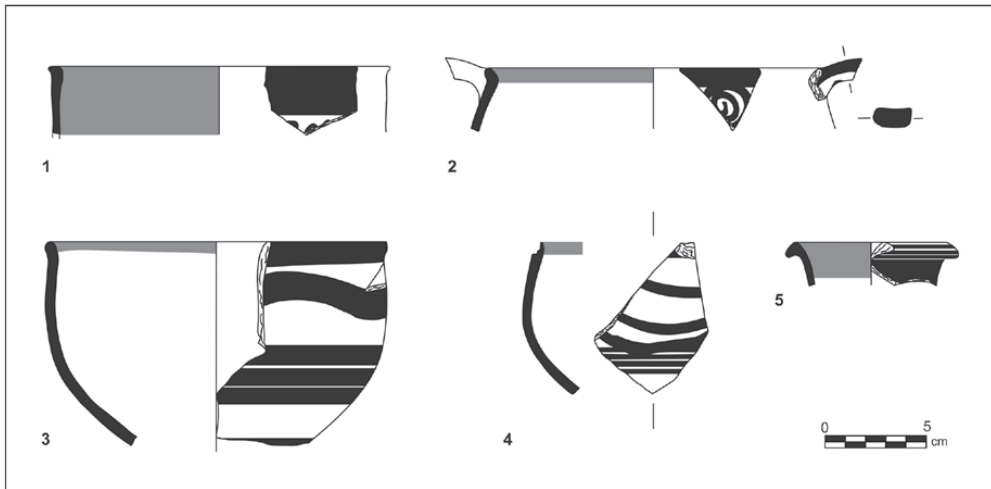


Figure 9.4 Mycenaean pots of LH IIIA–B from Thessaloniki Toumba, all to same scale (courtesy of Thessaloniki Toumba excavations; designed by Nikos Valasiadis).

and the transport and use of aromatic substances (alabastra and small piri-form jars) (Jung 2003) (Figure 9.4). Consequently, it can be assumed that the few Mycenaean-style vessels which reached the area during this period were employed in the same social occasions as their handmade, decorated counterparts. They served a small number of individuals who had the means to organise and participate in these special social events. In the context of these events, power and status were negotiated inside and among local communities (Andreou et al. 2001; Andreou 2003; 2010). The intrinsic value of the Mycenaean pots was mainly associated with their very different biographies, which led to their eventual domination over their handmade counterparts during the next phase (Kiriati et al. 1997; Kiriati 2000).

The third phase covers the 12th and 11th centuries BC (LH IIIC). In the period that followed the collapse of the Mycenaean polities in southern Aegean, the use of Mycenaean ware increased dramatically in central Macedonia (Jung 2002; 2003; Andreou 2003; 2009). Nevertheless, this ware continued to occupy only a small component of the tablewares used in the area and the range of shapes of Mycenaean vessels continued to be limited to a few decorated types used most probably for the consumption of wine and aromatics (Andreou and Psaraki 2007). The dramatic rise in the demand for the wheel-made decorated pottery signifies a considerable transformation in the character and the social significance of the occasions of its use during this period. It appears that the absence of well-defined power structures in the communities of central Macedonia and the lack

of control over communications by sea encouraged the growth of a number of groups and individuals who, through their ability to provide for the organisation of feasts or funerals where wine or aromatics were consumed in Mycenaean vessels (Figures 9.5 and 9.6), were able to display a new social identity in their communities.

Stylistic and analytical evidence, including chemical and petrographic characterisation, combined with technological macroscopic examination (Mommsen et al. 1989; Mommsen and Maran 2000–1; Kiriati 2000; Jung 2002, 49–56; Andreou 2003, 195–6; Andreou et al. 2003; Buxeda i Carrigós et al. 2003), indicate a number of different fabrics, each associated with distinct stylistic and technological features. This supports the scenario not of regular and targeted supply from a specific source but that of irregular and infrequent visits of boats bringing pots from a number of areas with whom the people on board were directly or indirectly associated. There is limited evidence that at least some of the sources are associated with areas in central Greece, such as Boeotia, Euboea or Thessaly (Mommsen and Maran 2000–1; Buxeda i Carrigós et al. 2003). What is interesting, though, is that several of these pots (and increasingly more and more of them) were made with the use of local raw materials. These are the so-called *local imitations* of Mycenaean pots. While they display the same basic repertoire of shapes and decorative motifs as known in the core areas of the Mycenaean culture, during this later period there are strong indications, in terms of shape and decorative preferences, for the establishment of a distinct regional style (Jung 2002; Andreou 2003; 2009).

As argued above, the Mycenaean-style pots were employed in the same practices with traditional handmade vases. In terms of technology, however, they were very different. The handmade pots comprise products of a long-lived tradition in the area, associated with well-established and widely shared perceptions regarding the choice of appropriate materials and the techniques of manufacture. As a rule, they were made with gritty and non- or low calcareous clays, formed through coiling and scraping or pinching (with no evidence for the use of rotating devices); their surface was usually burnished and the pots were fired probably in pits or single-space kilns. For those with a painted decoration, a manganese-rich paint was used, one that always fired dark brown with a purplish tint, independently of firing conditions or temperatures (Kiriati 2000).

The Mycenaean pots on the other hand, both the imported and those locally produced, were made with finer, usually calcareous clays, and were manufactured with the use of the wheel and rotative kinetic energy. They were painted with iron-rich paints that fired either red or dark brown to

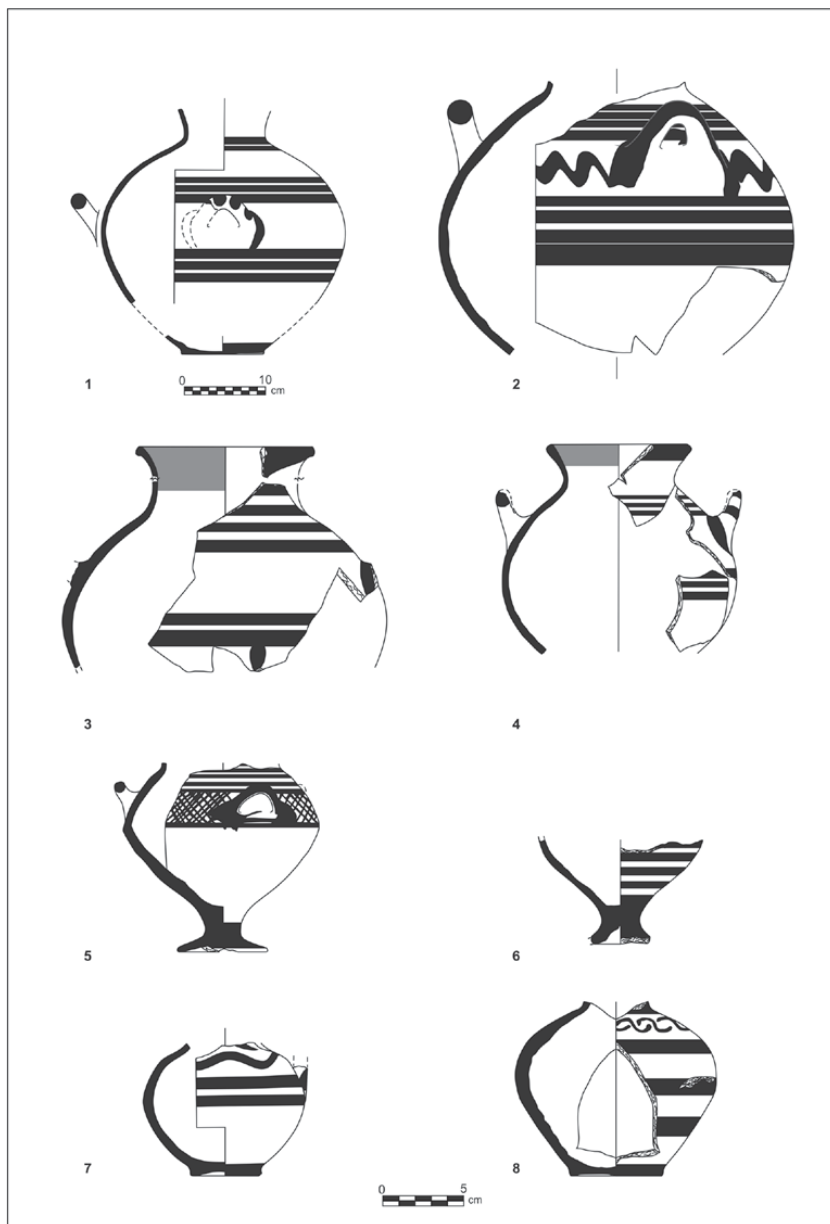


Figure 9.5 Mycenaean pots of LH IIIC from Thessaloniki Toumba (closed shapes), all to same scale (courtesy of Thessaloniki Toumba excavations; designed by Nikos Valasiadis).

black, depending on firing conditions. They obviously reflect more complex firing techniques than the handmade wares and, in most cases, the use of updraft kilns (Kiriati 2000; Buxeda i Carrigos et al. 2003). Despite the

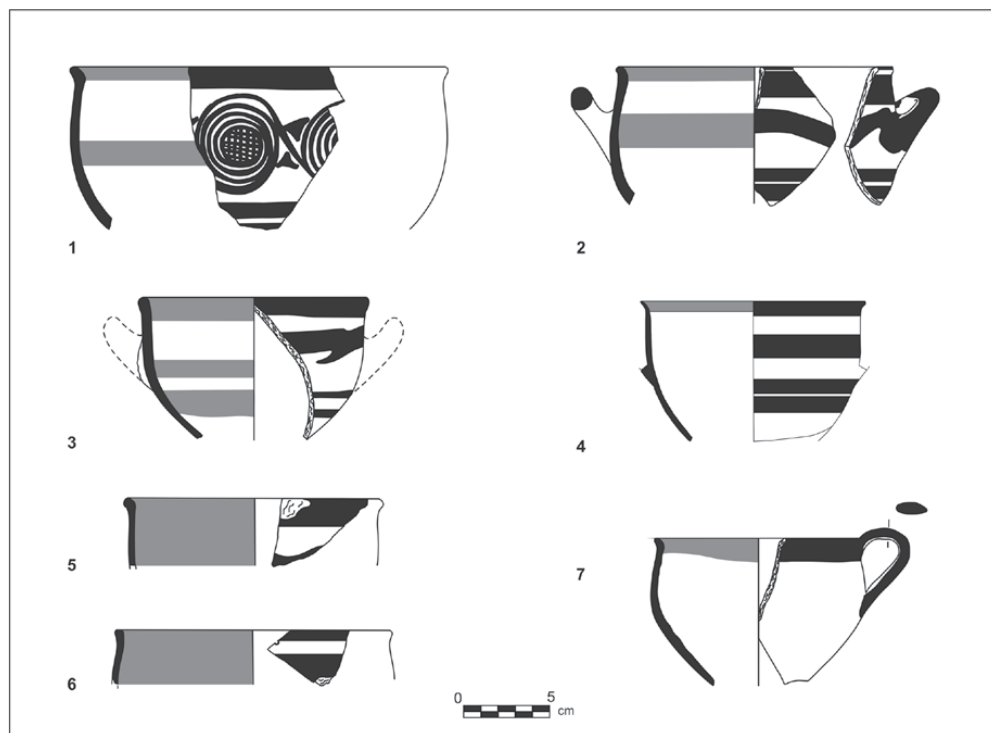


Figure 9.6 Mycenaean pots of LH IIIC from Thessaloniki Toumba (open shapes), all to same scale (courtesy of Thessaloniki Toumba excavations; designed by Nikos Valasiadis).

intra-regional variation observed in the manufacture of the locally produced Mycenaean pottery, mainly in terms of clay paste types and firing technology (Kiriati 2000; Buxeda i Carrigos et al. 2003), these vessels reflect a distinct potting tradition when compared to the local handmade pottery. The obvious differentiation between the two traditions rests primarily on the use of the very different forming techniques that require different motor habits and, more importantly, can be acquired through different learning processes. A much lengthier and more difficult apprenticeship is associated with the wheel-using techniques in comparison to hand-building ones (Roux and Corbetta 1989), during which the apprentice starts with the manufacture of small vessels and gradually proceeds to the manufacture of larger ones. In this case, it is important to stress that throughout this long period a close interaction and communication is required between the apprentice and the master and for this reason the apprenticeship takes place in certain social contexts where such a relationship can be secured. These are family groups or groups of people sharing a common language or other common communication codes (Gosselain 2011).

Moreover, the two distinct technological traditions reflect different production modes. The manufacture of wheel-made vessels, as opposed to the handmade pottery, reflects a more complex organisation of production, where significant labour is invested not during the manufacturing process but in the learning process. Thus the manufacture of wheel-made pottery tends to be related to higher degrees of specialisation and complexity in the organisation of production that the socio-political conditions in Macedonia could not fully support at that time (Roux and Corbetta 1989; Costin 1991; Kiriatzi 2000). Furthermore, the knowledge, the tools and possibly the required facilities (i.e. kilns) associated with the local production of Mycenaean-style pots must have been introduced from outside the area, from distant and to most unknown worlds (Kiriatzi 2000). This interaction would have charged symbolically the new technology and its products, but also those who could master it (Helms 1988; 1993).

Based on the above, it can be argued that the locally produced, wheel-made, Mycenaean pots in central Macedonia were not *imitations* of Mycenaean vessels produced by the potters of the local tradition. Instead, they must reflect the actual reproduction of the manufacturing technology of the proper Mycenaean potting tradition of the southern Aegean, at its most developed form (i.e. including the production of relatively large vessels) right from the beginning. It is most likely then that these pots were produced by a group of potters different to those of the handmade tradition, comprising two distinct 'communities of practice' (Wenger 1998). The potters of the former must have been trained in the context of the Mycenaean potting traditions, either in Macedonia or elsewhere in southern Aegean. In any case, the transfer of this technology could not have happened without the mobility of potters. It is important to emphasise, however, that the link between the local Mycenaean tradition and that of the south was kept alive since the local production of Mycenaean pots followed, although sometimes with a little delay, the stylistic developments taking place elsewhere in the Aegean. Perhaps the most suitable explanation for this situation is to assume the existence of continuous contacts, which materialised through visits to Macedonia by travelling potters from a number of areas of the Aegean. The relatively small amounts of Mycenaean pottery present combined with the variability of local and imported fabrics throughout the period among different sites provide additional support to the view given above.

It is worth looking at the way the two traditions, the two 'communities of practice', developed, in the context of the local societies. They remained completely distinct while continuing to coexist, suggesting that

the respective potters had separate social identities. Nevertheless, the exact nature of the relationship between the two traditions (and their respective potters) varied through time and across space, from one site to the other. Prior to LH IIIC no obvious assimilation or borrowings took place between the two traditions. The Mycenaean vessels followed southern Aegean standards, indicating that the travelling potters who produced these pots locally were not incorporated into local communities but were considered as outsiders/foreigners, with the same applying to their products. So one wonders if during this period there was any difference between the imported and the locally produced Mycenaean pots for the local consumers. They may have both been 'foreign' and they were probably distributed through supply networks different from those responsible for the circulation of the handmade pottery, possibly not directly controlled by the local communities. This situation started changing in the post-palatial phase, when local production increased and a regional Macedonian style was developed. During this period, despite the fact that the core of the two traditions remained distinct (different forming techniques, different modes of production and social contexts of apprenticeship), there are signs of variation in the way the Mycenaean potting tradition was reproduced and appropriated at different sites. While aspects of the Mycenaean tradition, such as the forming technique that involved the use of the wheel, remained unchanged, vessel forms at the coastal site of Agios Mamas occasionally adopted features of the local handmade tradition (Jung 2003). Likewise, in inland Assiros Toumba, wheel-made Mycenaean vessels were occasionally made with pastes or were fired in constructions similar to those of the local handmade pottery (Buxeda i Carrigós et al. 2003). Both instances refer to aspects of a technological tradition that one potter can more easily change due to interaction with other potters or due to consumers' preferences, as opposed to the forming technique which tends to be the most deeply rooted and the least-easy-to-change aspect of a potting tradition, associated, as a rule, with the potter's identity, origin or context of apprenticeship (cf. Gosselain 2000; 2011). The Agios Mamas and Assiros Toumba examples demonstrate that the reproduction of the Mycenaean potting tradition, while focusing on the reproduction of the forming technique, the type of paints and the patterns of decoration, followed different routes from site to site, as far as pastes, repertoire of vessel forms and firing techniques were concerned. The different processes of reproduction and appropriation of the Mycenaean potting tradition seem to reflect the incorporation of the potters in the local communities, although their roles remained distinct from those of the producers of the local handmade pottery. The two traditions reflected

the coexistence of two distinct communities of practice with limited (if any) sharing of knowledge. Consequently, we may infer that while, at the outset, the local Mycenaean pottery was produced by 'foreign' mobile/travelling potters, during LH IIIC its production was increasingly associated with settled, non-mobile potters. The gradual decrease in terms of technological variability and the increase of technological standardisation displayed in the LH IIIC and Protogeometric style assemblages of Thessaloniki Toumba and Kastanas of the end of the Late Bronze Age and the beginning of the Early Iron Age may suggest the rising role of such non-mobile producers of wheel-made pottery at certain, primarily coastal sites, during this period. On the other hand, the disappearance of these styles of pottery from Early Iron Age deposits at Assiros Toumba indicates that the changing socio-economic conditions discouraged the continuation of the reproduction of the wheel-made pottery tradition at certain inland sites, resulting in its eventual disappearance.

During the same post-palatial phase, Mycenaean pottery penetrated also into the more distant inland areas of upper Macedonia and the middle and upper Axios valley (Karamitrou-Mendesidi 2000; Mitrevski 2007; Videski, 2007). In these instances, a very different process is implied, deviating significantly from the complex processes of incorporation of the foreign potting tradition described above. In these cases, apart from sporadic actual Mycenaean pots penetrating through local networks, only elements of the original vessel repertoire were visually copied by the local potters and decorated with techniques and patterns used in the traditional handmade pottery, a phenomenon that need not be associated with potters' mobility.

Central Mediterranean

In the central Mediterranean, the phenomenon of Mycenaean pottery shows certain similarities, but also differences, when compared to central Macedonia.

Despite the impressive number of sites recorded as having Mycenaean pottery (at least 93, Blake 2008, 1), and the long time span it covered (almost half a millennium, from pre-palatial LH I to post-palatial LH IIIC), the actual quantity appears rather low, especially when compared to sites in the eastern Mediterranean (van Wijngaarden 2002; Vianello 2005, 32). Such pottery appears predominantly in southern Italy and Sicily while only a few pots seem to have travelled north of Apulia and Campania (Vianello 2005, 43–57) and west of Sardinia (de la Cruz 1987).

The beginning and subsequent development of the phenomenon in the region shows a chronological trend similar to that of central Macedonia. This pottery first appears in limited amounts during the early Mycenaean pre-palatial period,⁴ its quantity increases, together with the start of its local production, during the palatial phase and it reaches its highest frequency, with its majority being locally produced, during the end of the Aegean palatial and in the post-palatial era (Jones et al. 2005; Vagnetti et al. 2009).

Contrary to the consistent repertoire of Mycenaean vessel forms in central Macedonia, considerable regional and chronological variation is recorded in the central Mediterranean in terms of vessel types. Beyond the wider range of Mycenaean pots, there is a slight dominance of closed vessels over open ones, indicating the important role of such pots as containers of specific contents (Blake 2008). Moreover, the focus of the distribution of the Mycenaean pottery shifted over time, from the Tyrrhenian Sea and Sicily in the early phase to the Ionian and Adriatic coast of southern Italy during the advanced phase. Such patterns obviously reflect variation and changes through time both of consumers' preferences and suppliers' interests (Vianello 2005; Blake 2008; Iacono 2013).

Overall, three classes of pots have been identified in sites of central Mediterranean that bear associations with the Aegean and the so-called Mycenaean tradition. Large-scale compositional and technological analysis of all three types has provided a good understanding of their respective production and circulation patterns (Jones et al. 2002a; 2005; 2013). The first class concerns imports from various parts of the Aegean, mostly the Peloponnese, but also from Rhodes, Crete or central Greece. The second class comprises the so-called Italo-Mycenaean, or local Mycenaean, pottery which was identified to have been produced in a small number of locations in southern Italy (Jones et al. 2005; Vagnetti et al. 2009), in association with settlements having a nodal role in local networks (Iacono 2013). Materials and techniques used for the production of this pottery were so similar to those of the imported Mycenaean pots that it was difficult in some cases to distinguish imported and local products without chemical analysis (Buxeda i Carrigos et al. 2003; Jones et al. 2005). Based on this evidence and the increased production of such pottery, it has been argued that it reflects the arrival and settling of foreign, i.e. Aegean, potters in the area (Jones and Vagnetti 1991; Vagnetti 1999). The third class of pottery, the

⁴ In many cases the pottery is invariably dated to Late Helladic/Late Minoan I–II periods, indicating possible Cretan links.

so-called Mycenaean-derived, does not actually comprise a homogeneous group but includes a number of different types, such as grey wares, wheel-made pithoi (dolia) and a broad group of, later, painted pottery invariably called Figulina, Southern Italian Protogeometric or matt-painted pottery (Buxeda i Carrigos et al. 2003; Iacono 2013, 267–71). The production of these pots started after the local manufacture of the proper Mycenaean vessels and it is associated with the same production locations and the same basic technology, usually involving the use of the potter's wheel and/or firing kilns. For this reason, they are considered to have been manufactured by the same potters as those producing the local Mycenaean wares, who developed new vessel forms or decorations echoing local preferences/needs and in some cases borrowings from the local repertoire of the handmade pottery. This reproduction of the Mycenaean potting tradition, however, remained distinct from the local handmade one associated with the so-called *impasto* pottery. The new technology associated with the potter's wheel and firing kilns was never widely adapted by the local community (Buxeda i Carrigos et al. 2003; Levi 1999). Hybridisation was very limited and involved mainly the visual imitation of local handmade vessel forms by the bearers of the Mycenaean potting tradition without any actual transfer of technological knowledge. This phenomenon, which appears to be fairly localised, is considered to reflect the incorporation of the Aegean potters (or their offspring or trainees) in the social life of local communities (through marriages, alliances, etc.). As the two potting traditions, the Aegean-derived one and the local, remained discrete, their potters presumably comprised two distinct, although coexisting, 'communities of practice' with no or minimal sharing of knowledge (Loney 2007). This situation shows similarities to the analogous coexistence of two distinct pottery traditions in central Macedonia, as discussed above. In the latter case, the evidence for the incorporation of the potters of the new tradition in the local communities was more limited and seems to have taken place later, mainly in LH IIIC. Beyond the different local socio-economic conditions in each case and the varying Mycenaean interest in each area, the lengthier and more risky travel to the central Mediterranean may have encouraged the lengthier stay of Aegean potters in Italy, which in turn may have encouraged closer interaction and often the settling and greater integration of potters into the local communities.

By the end of the Italian Recent Bronze Age (early LH IIIC middle) the majority of Mycenaean and related wares were locally produced. As in contemporary Macedonia, these objects were not *exotica* anymore, but

gradually entered the realm of conventional goods used in certain local practices. Moreover, their wide, although sparse and selective, distribution across the region, reaching sites in central Italy, the Po valley and Sardinia, indicates their entanglement in local networks, which presumably put great emphasis on the procurement and circulation of metals (Jones et al. 2002b; Iacono 2013; Jung and Mehofer 2013). It becomes obvious that the local communities acquired a more active role in links with the Aegean, and the production and distribution of the associated pottery, while there is evidence already from the preceding period for a two-way interaction with the presence of the so-called Handmade Burnished Ware in Aegean sites (Iacono 2012; Jung 2012). On the other hand LH IIIC middle-late Aegean-type pottery in the west is almost completely absent.

In the central Mediterranean, the technological innovation associated with the Aegean-type pottery appears to have been partly accepted by certain local communities. This adoption, however, was temporary and of limited extent, as local socio-economic conditions, at the time, provided no motivation and opportunity for the wider incorporation of such an innovation in the pre-existing system of household pottery production. The impasto pottery continued to be used in all aspects of life and the local manufacture of the various types of Aegean-derived pottery gradually faded away during the final BA (Loney 2007). This picture finds parallels to the vanishing of the Mycenaean potting tradition mainly in inland areas of central Macedonia (e.g. Assiros: Wardle and Wardle 2007), but it contrasts with the developments in other communities of the same region, mainly in coastal areas, where the wheel-made pottery tradition was assimilated and appropriated alongside the pre-existing local potting tradition. These latter communities obviously remained connected to the interaction networks of the Aegean over the transition to the 1st millennium BC.

East Aegean and East Mediterranean

Turning to the areas east of the core Mycenaean world, that is the east Aegean, Cyprus, the Levant and Egypt, the available evidence is of a different nature and interpretations have followed different pathways, partly also because of the different research approaches employed there. The common trend across these areas is the increase in the imported Mycenaean pottery up to the end of LH IIIB, that is the end of the Mycenaean palatial era (Hankey 1967; 1970–1, 18–21; 1993a; 1993b; Leonard 1994; van Wijngaarden 2002). During this time and usually towards the end of the

period, there is varied, and usually limited, evidence for local production of Mycenaean wares that, in many cases, increases in the post-palatial LH IIIC period (not necessarily following always a linear evolution (see [Jung 2011b](#), for Cyprus where he sees a break and change in repertoire). Concerning use, as in Macedonia and the central Mediterranean, Mycenaean vessels seem to have been incorporated into pre-existing practices (see [Steel 1998; 2002](#), for Cyprus and the southern Levant; see [Stockhammer 2012a](#) for the northern Levant). In the Levant and Egypt, closed vessels traditionally associated with aromatic substances predominate while tablewares are far less common ([Hankey 1970–1](#), 18–19; [1993a](#), 104; [Steel 2002](#); [van Wijngaarden 2002](#)). In Cyprus, there is a preference for drinking sets with pictorial decoration by local elites, while containers of aromatic substances are preferred by non-elite members of the society who could not afford the analogous containers in Red Lustrous wheelmade ware used by the elites ([Steel 1998](#)).

Although the intensity and exact nature of the phenomenon varies across this vast and culturally heterogeneous region (see [Bell 2005](#), on variation in frequency and repertoire of Mycenaean pottery across the Levantine coast), there are two general trends. The first trend concerns the origin of the imports up to the end of the Mycenaean palatial era. Contrary to the high variability of fabrics attested in the Mycenaean pottery in central Macedonia, and less so in central Mediterranean, reflecting a number of sources, in the case of Mycenaean pottery in the east Aegean and east Mediterranean, a dominant fabric group is always attested, along with a small number of other minor ones. In all cases, this dominant group has been associated originally with Mycenae-Berbati or subsequently more broadly with a number of production centres in the NE Peloponnese ([Jones and Mee 1978](#); [Jones 1986](#); [Mommsen et al. 1992; 2001; 2002](#); [Karantzali and Ponting 2000](#); [Kling 2000](#); [Mommsen and Maran 2000–1](#); [Mountjoy and Mommsen 2001; 2006](#); [Badre et al. 2005](#); [Marketou et al. 2006](#); [Zuckerman et al. 2010](#)).

The second trend concerns the local production of Mycenaean pottery. Although the emphasis of research so far has been on the stylistic analysis of vessel forms and decoration and on the context of consumption, it could be argued that in most cases the technology of the Mycenaean potting tradition did not differ hugely from local traditions, at least in terms of forming techniques and organisation of production (contrary to the situations in Macedonia and central Mediterranean). Both in western Anatolia/east Aegean and in the Levant/Egypt, wheel techniques were employed to produce standardised and mass-produced wares. The situation is not so clear in Cyprus, where handmade and wheel-using potting traditions (with the

latter somehow fading after LBA I) already coexisted prior to the production of Mycenaean ware on the island (Crewe 2007; Crewe and Knappett 2012). The local production of Mycenaean pottery in Cyprus, concerning distinct pottery types and fabrics and occasionally different production locations (Knapp 1993; Kling 2000; Jung 2011b), may reflect a case of the reintroduction of the potter's wheel technology. It is noteworthy that in most cases where analytical studies were undertaken, up to the end of LH IIIB/the palatial period, the local Mycenaean pottery was associated with a distinct fabric (e.g. Karantzali and Ponting 2000; Kling 2000; Marketou et al. 2006; Mountjoy and Mommsen 2006) and not much interaction can be recognised between Mycenaean pottery and local traditions (Marketou et al. 2006; Vitale in press). Besides, Mycenaean vases comprised only a small part of the assemblage at each site. Although the evidence is not conclusive, it does not contradict the presence of travelling potters, as a distinct community of practice that did not mingle with the local potters. Moreover, the evidence presented so far on local production of Mycenaean pottery concerns mainly the Anatolian coast/east Aegean and, to a lesser (and more confusing) degree, Cyprus (Kling 2000), while it is inconclusive about the Levant prior to the post-palatial period. One wonders if there is any local (re)production of Mycenaean pottery by travelling potters in the Levant until the end of the palatial era, as much of the evidence concerns imported Mycenaean pottery that reached the region through various trade networks (Bell 2005). In the subsequent post-palatial period (although in places like SE Aegean even in the palatial period: Vitale, in press), there is evidence for a complete transfer of Mycenaean/Aegean traditions relating not only to pottery but to other aspects of life and/or death, indicating above all conditions of more intense mobility and transfer of technological practices, resulting in wider integration of lifestyles. Discussions diverge in these cases between migrations and the transformation of cultural identities, following a plurality of approaches and interpretations (Sherratt 2009; Yasur-Landau 2010; Jung 2011b; 2012; Vitale 2016).

Concluding Remarks

Some distinct patterns have started to emerge. For example, the Argolid's contacts seem to aim mainly at the east Mediterranean and, one can assume, some degree of state-directed contacts and gift exchange between rulers. The Argolid's interest in the east was not paralleled, however, by a direct interest in the north Aegean areas, where contacts seem to have

had a more random and entrepreneurial character, associated mostly with the irregular and infrequent visits of independent merchants and mobile craftspeople rather than being directed by the palaces. On the other hand, it is assumed, but still remains to be confirmed, that the south and west Peloponnese, as well as Crete, put more emphasis on contacts with the central Mediterranean, while some of the less politically powerful and rich polities of central Greece may have had to turn to the north Aegean. The undertaking of such endeavours seems to have been crucial for the reproduction of Mycenaean societies, both at the level of the palatial state and of its individual members, mainly due to the need for raw materials and the link with exotic worlds/travel (etc.). Possibly, not all states were able (politically and financially) to support such expeditions in the same way and scale, while the assumed alliances or competition between the various states may have influenced each state's involvement.

Overall, it becomes evident that travelling potters/craftspeople (together with seamen, merchants, state officers) played a significant role in the spread of Mycenaean ways of doing things and the emergence of trans-regional styles, in parallel with local potting traditions. Although it seems that it is a generalised phenomenon that grows in intensity from the 14th to the 12th century BC, its impact and implications vary hugely from one area to another, and even from one settlement to another within the same region, depending both on the pre-existing socio-political background in each case, and the contemporary historical conditions. By the post-palatial period however, the Mycenaean way of doing things had evidently become an integrated part of the ways of doing things in numerous sites in the northern Aegean, the east and central Mediterranean, reflecting the incorporation of potters working in the Mycenaean tradition in various communities. Their products were probably not consumed any more as 'foreign' commodities, but had become vital parts of local traditions that were internally richer and more varied than previously. The fact that some cultural traits, among which the use of Mycenaean pottery is probably the most obvious, were shared widely by communities spread over a large part of the Mediterranean, probably facilitated further the mobility of small groups and individuals evident during the 12th and 11th centuries BC.

A multi-scalar and technology-based approach can make a significant contribution to the better understanding not only of the socio-political role and the identities of the travelling craftspeople, both in the context of the home and the host societies, of the impetus for their mobility, and of their role and necessity for the Mycenaean world, but also of how

this whole phenomenon transformed, and was transformed by, the local societies in each case. Some of the questions that emerge concern the internal heterogeneity of the Mycenaean world as such. What has been typically referred to as a Mycenaean world/society/core area, is currently considered as an assemblage of autonomous polities that often allied with one another for political and economic gain, while sometimes competing and even engaging in inter-state warfare ([Wright 2008](#)). This has significant implications especially for the study of intercultural interaction. Issues that were only touched upon here, but are worthy of future investigations, concern the time-frame, direction, character and political context of such contacts.

KRISTIAN KRISTIANSEN

Abstract

It is argued here that the new forms of mobility instantiated by the demand for metals set Bronze Age political economies apart from what had gone before. Transport by sea and by land was transformed by innovative technologies (the sail, the chariot), enabling long-distance mobility, especially when combined. These changes helped create a new interconnected 'globalised' world without historical precedent. In this chapter, it is suggested that flows of people and material were facilitated by certain social institutions, with a widely shared tradition of warrior chiefs and traders primarily responsible.

Introduction

In order to reach an understanding of the scale and organisation of ancient trading and travelling networks we must be able to combine at least three separate and demanding fields of research: the nature of ancient knowledge of the world (their cognitive maps, sometimes preserved in texts, more often not), the nature of mobility technologies and their capacities (from ships to wagons and caravans, but also the infrastructures/logistics to support them), and finally archaeological knowledge of the goods being traded/moved, their origin and distribution. In addition there is the difficult question of quantities being transported. To unify these three realms of research demands the construction of relevant interpretative frameworks. To achieve this it is necessary first to assemble as much comparative theoretical knowledge as possible about the role of travel, not least the kind of institutions needed in order to carry out long-distance trade (Kristiansen and Larsson 2005, ch. 2; Neipert 2006; Oka and Kusimba 2008). Therefore, I shall begin by discussing some recent theoretical and methodological advances in the study of prehistoric interaction and mobility.

I wish to sincerely thank my Italian colleagues working in the Po region and in northern Italy for their help in providing me with up to date literature on the Terramare culture. Their names will be apparent numerous times in the bibliography and my interpretations on the Terramare culture rely heavily on their groundbreaking, interdisciplinary work.

Theorising Mobility: Cognitive Geographies and Networks

Network analysis has once again come to the fore of archaeological methodologies, as a means of expanding materiality studies with new powerful analytical techniques and a broader theoretical repertoire (Knappett 2011a; 2013). This theoretical wedding of agent-based materiality studies with quantitative analytical techniques may be seen as an attempt to overcome the dichotomy of macro versus micro theory: the structural/top-down constraints of world system theory, with its related concepts of institutionalised interaction (Kristiansen and Larsson 2005, ch. 1), and the analytical/bottom-up constraints of personalised, agency-based materiality theory of things and humans (Knappett 2005; Fahlander and Kjellström 2010; Olsen 2010). Network analysis seems to provide an attractive interpretative ‘tabula rasa’ for a multivariable approach with free-moving agents – material and human – at the forefront. It further attempts to integrate both micro and macro perspectives into a scalar approach (Earle and Kristiansen 2010b, fig.1.3; Knappett 2011a). This is in line with recent theoretical attempts to bridge the gap between a materiality approach whose success has mainly been at the micro level, often in rich historical/and or archaeological contexts (Meskell and Joyce 2003; Knappett 2005), with new insights from the ongoing science revolution in archaeology, such as strontium isotope analysis and ancient-DNA. So far results of the latter have demonstrated that human mobility was much more profound in prehistory than previously assumed (Knipper and Price 2009), not least in the Bronze Age (Price et al. 2004; Linderholm 2008; Chenery and Evans 2011; Pokutta 2013). Therefore migrations, travels and other forms of interaction and mobility have come to the forefront of archaeological interpretations and debate (Krenn-Leeb et al. 2009; Dziegielewski et al. 2010; Cabana and Clark 2011). The theoretical and historical implications of this knowledge revolution will be profound, as it lifts the forces of historical change away from the local context onto a much larger geographical scale of multiple local interactions, creating a constant flux of connectivity and productivity without fixed boundaries. Consequently change and stability reside in the success or failure of being connected. Karl Marx’s interlinked theoretical concepts from the introduction to his ‘Critique of the Political Economy’ – production, distribution and consumption – suddenly become relevant for understanding Bronze Age dynamics on a local and global scale, and the old debate about the origin of capitalism in the Bronze Age seems not too far-fetched (Kristiansen 1998, ch. 1.2; Ekholm Friedman and Friedman 2008, ch. 5). To get there,

however, we need not only individual agents, whether merchants or mercenaries, but also institutions and larger social and economic systems as vital ingredients of future theoretical frameworks. We can no longer allow ourselves to exclude one frame of geographical and theoretical reference at the expense of others. Here the world system approach still seems to offer a viable, if modified theoretical framework for interaction studies (Parkinson and Galaty 2009), in tandem with a new theoretical surge for comparative studies (Earle and Kristiansen 2010b; Smith 2012).

So far, interpretations of the materiality of intercultural dynamics of various kinds have tended to focus on cultural change – transculture, hybridity etc. – rather than identifying the social and economic forces behind such changes (Alberti and Sabatini 2012; Maran and Stockhammer 2012). In this contribution I propose that, to understand the role of culture and materiality in studies of mobility, we need first to understand the underlying dynamics and forces leading to material and cultural change. Most importantly here are the institutions that organise such flows, whether trade emporia, political alliances, clients or sailors/traders and their institutions.

Networks need agents with motivations to travel, technologies of mobility to support them, and institutions to provide social security (Kristiansen and Larsson 2005, ch. 2). All of these conditions are summarised in a mental template of cognitive geographies that makes distance and dangers, routes and destinations familiar to the traveller, and which were often preserved in mythology and oral traditions about distant geographies, from Odysseus to Pytheas (Cunliffe 2001; Lane Fox 2008; Duerr 2011). In this way they make the world seem smaller, as distant places become familiar, at least to the professional traveller, whether sailor, trader, tinker, warrior or some mix of all that. Their profession is about transgressing traditional liminal borders and connecting distant places and their goods, making a profit in the process (Monroe 2011). A few citations may illuminate this:

- From Malinowski (1932) on kula mythology: “Here we must try to reconstruct the influence of myth upon this vast landscape, as it colors it, gives it meaning, and transforms it into something live and familiar” ... “I often observed how deep was their interest in sections of landscape impregnated with legendary meaning, how the elders would point and explain, the younger would gaze and wonder, while the talk was full of mythological features.” ... “Men say their true personality can only be expressed in the kula. Kula men see their ceremonial exchange activity as their best potential avenue for immortality.”
- Homer on trading and travelling, in the words of Menelaus: “But when it comes to men, I feel that few or none can rival me in wealth, for it

took me seven years and great hardship to amass this fortune and bring it home in my ships. My travels took me to Cyprus, to Phoenicia, and to Egypt. Ethiopians, Sidonians, Erembians, I visited them all; and I saw Libya too ..." (*Odyssey* 4.75–85). It covers a good deal of the roundtrip of the Uluburun ship, although its cargo also contained objects from faraway places such as Scandinavia (amber), Italy (flange-hilted sword), the Black Sea area (stone-axe sceptre), and Iberia/Cornwall (tin) (Tas and Özbirecikli 2009).

Our interpretations must strive to reconstruct the conditions that formed the basis for cognitive geographies during prehistory. This was dependent upon the social complexity of the societies under study. Rather than return to an evolutionary theoretical past, I propose that we should employ the concept of *historical epochs* as a defining social framework. They are characterised by a number of shared conditions – whether economic, technological or social – that integrated societies and allowed them to interact. The level and degree of interaction determined the scale of the epochal structure, defined by some as a world system. It implies that societies were linked together by a common historical destiny at the level of macro-history. The limits or constraints of such epochal foundations define the conditions for their transformation and downfall.

The Bronze Age represents such a historical epoch with a number of shared conditions that makes it qualitatively different from the preceding Neolithic epoch, and much closer to what came after. It was these shared conditions and values that allowed interaction to take place and create an interlinked world from Mesopotamia to Scandinavia at its height during the mature Bronze Age. However, the conditions of the world-historical epochs are defined by the centres, and only gradually would larger regions come under their influence to varying degrees. How this was brought about and unfolded is covered in my book with Thomas Larsson (Kristiansen and Larsson 2005, but see also Beaujard 2012). In the following I will therefore exemplify how the rise of new institutions and technologies expanded Bronze Age mobility and connectivity, and created new conditions for interaction, and consequently for the movement of goods, people and knowledge.

The Rise of New Mobility Technologies and Institutions

The Bronze Age was a mobile world for the very simple economic reason that copper and tin, or bronze in finished or semi-finished form, had to be distributed to all societies throughout the known world from a few

source areas. Systematic trade in staples such as copper and tin (Shennan 1993; Bartelheim and Stäuble 2009; Bell 2012), woollen textiles and salt (Kern et al. 2009; Monroe 2009; Harding and Kavruk 2010; Harding 2011; Kowarik et al. in press) formed the backbone of Bronze Age economies. The control of copper and salt mines and the subsequent trade in these commodities had the same economic significance as the control of and trade in oil and gas resources have today.

During the Bronze Age such trade was couched in political alliances where prestige goods played an important role in forging such relationships – whether in Barbarian Europe or in the Near East, as exemplified in the ‘Amarna diplomacy’ (Cohen and Westbrook 2000). One precondition for the operation of this economic and political system that was based on a dialectic between staple and wealth finance (Earle 2002) was the rapid development of new maritime technologies during the late 3rd and early 2nd millennium BC, which for the first time allowed safe sea journeys over longer distances and provided larger ships that carried bulk cargoes across open waters (Rowlands and Ling 2013). Likewise, the chariot symbolised a new speedy transport for warfare that had long-term historical consequences in the use and breeding of horses for transport (Kelekna 2009).

These technological revolutions expanded the potential for long-distance mobility and interaction on a systematic basis from the beginning of the Bronze Age, and by combining sea and land-based journeys new regions could suddenly be connected. In addition, the multitude of routes promoted competition. It also expanded the demands for specialists to take care of travels – including shipbuilding and navigating at sea, and the construction of wagons and training of horses for land transport. New specialised social groups or classes emerged, with a new institutional framework to support them, and at the same time such specialists expanded the cognitive geographies of Bronze Age communities tenfold or more. The recent demonstration of the geographical knowledge that the Old Assyrian trading families mastered in order to organise and control the metal trade in Anatolia is staggering (Barjamovic 2011).

The regular connectivity between Bronze Age communities meant that knowledge could be obtained about faraway places on a regular basis. Traders were the new specialists that provided such knowledge and the organisational skills to connect distant places and their goods. But also warriors became widely sought after as mercenaries in the east Mediterranean during the Late Bronze Age from the 15th century BC onwards, as is well attested in texts and on stelae, not least in Egypt (Morkot 2007). It explains how new sword types would spread rapidly from the Mediterranean to

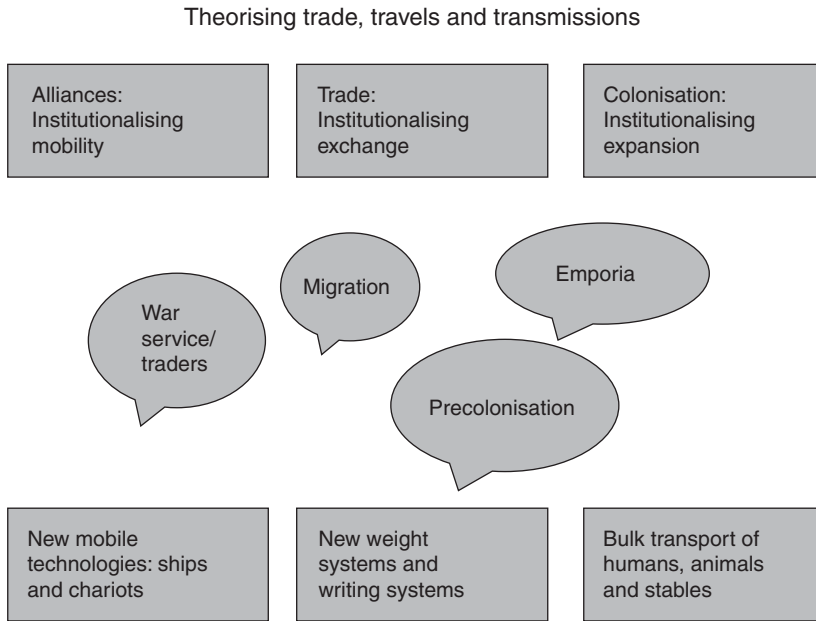


Figure 10.1 Model of mobile Bronze Age specialists and their institutions (created by Kristian Kristiansen).

Scandinavia probably within a few years. Thus the combination of trade in metal and possibly in arms, as well as travelling warrior groups and their attached specialists, created an interconnected ‘globalised’ world without historical precedent.

It was a world whose social and political complexity spanned from city-states and palace economies in the eastern Mediterranean to chiefdoms of varying degrees of complexity in the western Mediterranean and Europe (Parkinson and Galaty 2009; Papadimitriou and Kriga 2012). However, there existed certain commonalities in social organisation that allowed metal to flow between all these communities. The question then becomes, what were the social mechanisms that facilitated this flow of goods and metal? Which social categories of people could travel and for what reasons? Which were the institutions that facilitated their travels? And finally, which were the technologies that supported such travels, over land and at sea?

In Figure 10.1, I list what I consider to be relevant categories of people/social groups, and their relevant institutions.

The categories of people who travelled were traders/smiths, craftspeople, warriors/mercenaries, migrants and diplomats. Among the examples from the Bronze Age one can mention the Uluburun and Cape Gelidonya shipwrecks as examples of the maritime technology that allowed bulk-trade, and

which also carried warriors/mercenaries to distant courts, while they at the same time protected the cargo, whereas the Sea Peoples exemplify migrations and colonisation during the 12th century BC, followed by overland migrations in the Balkans during the 12–11th centuries BC (Aslaksen 2013).

Agents – whether traders, mercenaries or merchants – can only travel if there exist routes, harbours and institutions to facilitate and protect travellers. The institutions or social processes that allowed such movements are political alliances, and linked to that the rules of guest-friendship, for merchants, emporia and colonies, treaties and contracts. Historical examples are the Old Assyrian Karum trade to Anatolia during the 19th and 18th centuries BC, a model followed throughout the Bronze Age (Monroe 2009), and supported by international diplomacy (Cohen and Westbrook 2000). The textually well-documented Near Eastern trade (Larsen 1976; 1987; 2007), and the Uluburun sunken cargo (Pulak 1998) – a single unsuccessful journey out of probably dozens of similar successful annual maritime transports – exemplifies the severe problems we are up against when trying to interpret the scarce material evidence of the lives of traders, as they mostly left scant archaeological evidence (Cline 2007), perhaps with the exception of their burials (van Wijngaarden 2012). By comparison with the Near East it is justified to ask whether so-called Mycenaean pottery and settlement evidence in the western Mediterranean, in Sicily and south Italy and later also further north in the Adriatic, are indications of small groups of private traders/families that created a form of Karum trade. They would be embedded within local kingdoms/chiefdoms, as the Assyrian traders in Anatolia, therefore leaving only scant traces of their presence (Mederos Martin 1999; 2012; Cazzella and Recchia 2009; 2012; Tanasi 2009; Vianello 2009; but Jung 2005 and Blake 2008 for a sceptical view). One might call it a maritime parallel to the land-based Near Eastern trade, forming a kind of pre-colonisation (Ruiz-Galvez Priego 2008), to be followed up during the subsequent centuries by Phoenician and later Greek colonisation (Celestino et al. 2008). Indirectly, however, the traders' craft can be demonstrated in the gradual adoption of weights and standards of weight spreading from the Near East to the Aegean and later on to Europe during the Bronze Age (Rahmstorf 2010b).

With reference to later historical parallels of Celtic and Germanic mercenaries who, after their service had ended, returned home with Roman weapons and prestige goods, we are justified in interpreting similar evidence of Greek armour in east central Europe during the 13th century BC (Goetze 1984) as evidence of returning mercenaries from the Mycenaean palaces where central European and not least Italian flange-hilted swords

testify to their presence during the same period (Jung and Mehofer 2005/2006; Jung 2009b). However, some stayed and became local warlords (Giannopoulos 2008), and would perhaps later invite larger groups to come and settle during the 12th and 11th centuries BC, bringing with them their local pottery traditions, as testified by Italian-style pottery in several areas of the east Mediterranean (Lis 2009; Jung 2012).

I suggest that these and related questions of political alliances, war-service, trade and migrations can be answered with greater certainty today than forty to fifty years ago, not least if we employ historical models, such as the Old Assyrian Karum trade, its later successors, and make controlled comparisons on the much richer archaeological and textual evidence at hand.

In the following pages, I present three case studies to illuminate this new Bronze Age world of organised interconnectivity. My examples will cover maritime networks, as well as land-based networks, their institutionalised materiality and subsequent historical effects, including diasporas and migrations.

The Formation of New Maritime Institutions in Scandinavia and Beyond

During the Nordic early Bronze Age we see the emergence of two inter-linked phenomena along the shores of Scandinavia: from around 1500 BC thousands of cairns are built in the rocky archipelago and along the coast, visible mainly from the sea (Kristiansen 1987). At the same time starts the carving of rock art with thousands of engraved ships, often at sheltered, good landing locations (Ling 2008). These two phenomena represent the ritualised materialisation of a new social group of sailors and shipbuilders who were in charge of regular seaborne maritime transports that connected the several thousand kilometre-long Scandinavian coastline, and distributed metal, goods and people, especially warriors (Kristiansen 2004). In addition this new maritime network created the basis for expanding and maintaining a shared Nordic culture, which appears for the first time with the Bronze Age.

The new institution employed the hardness of stone as their ritual landmark, whether as engravings in the rock or as stone-built, sometimes elaborate, cairns. It marks a stark contrast to the wet environment that was their daily and dangerous working place while they paddled the large seagoing canoes. It also marks a stark contrast to the landholding elites who built

barrows of grass turfs from their land, and who apparently monopolised and controlled most of the metal trade.

Already from the early Bronze Age c.1700–1500 BC we find the fully developed plank-built boat of the Hjortspring type, which was to dominate sailing for more than a thousand years. On the Rørby sword the oarsmen are depicted in pairs, making up a large crew of thirty-two, plus a helmsman. The ships are clearly constructed with a stern and a keel extension to help keep the boat on course. Ling has made a systematic study of crew numbers for western Sweden (Ling 2012), and demonstrates that six to twelve is the most common, which remains the norm during the Bronze Age. Larger ships with thirty to sixty crew strokes also occur, like Rørby. These are the chiefly boats for rituals and display. The normal boat crew of six to twelve may represent a local community, each household providing one paddler/warrior. A similar number of households were calculated for the retinue of chiefly warriors in south Germany and central Europe (Sperber 1999, 637ff.; Sicherl 2004, 199ff.). It suggests a social regularity among Middle Bronze Age societies.

It is a general trend that boats become smaller during the Late Bronze Age, and here they follow the trend from house building. It may indicate a general shortage of timber, as is evident from northwestern Jutland already from Montelius period III (Holst et al. 2013). We may envisage that some regions rich in timber and sailing traditions, like Tanum in western Sweden, became specialised maritime chiefdoms that provided services for other regions and perhaps also boats. The skills in navigating the long sea-journeys must have necessitated a certain critical mass of boats and seamen that not every coastal community could boast, and these long-distance sea-journeys also demanded elaborate rituals. Therefore we find concentrations of rock art in those regions that held such a position in the overall system of metal trade and communication (French 2010, plate 2.1).

We see therefore the emergence of a new complex political economy, with two social groups and institutions in charge of different aspects of the economy, and with distinctively different ritual materialisations in the landscape. Whether we should also call them different ethnic groups remains uncertain, but we can with some certainty conclude that a specialisation and subsequent division of labour had taken place, which led to the formation of a new maritime fishing and trading economy. We may also conclude with some certainty that the maritime traders had contracts of delivery of metal upon their return to the landholding chiefly elites, and some investments

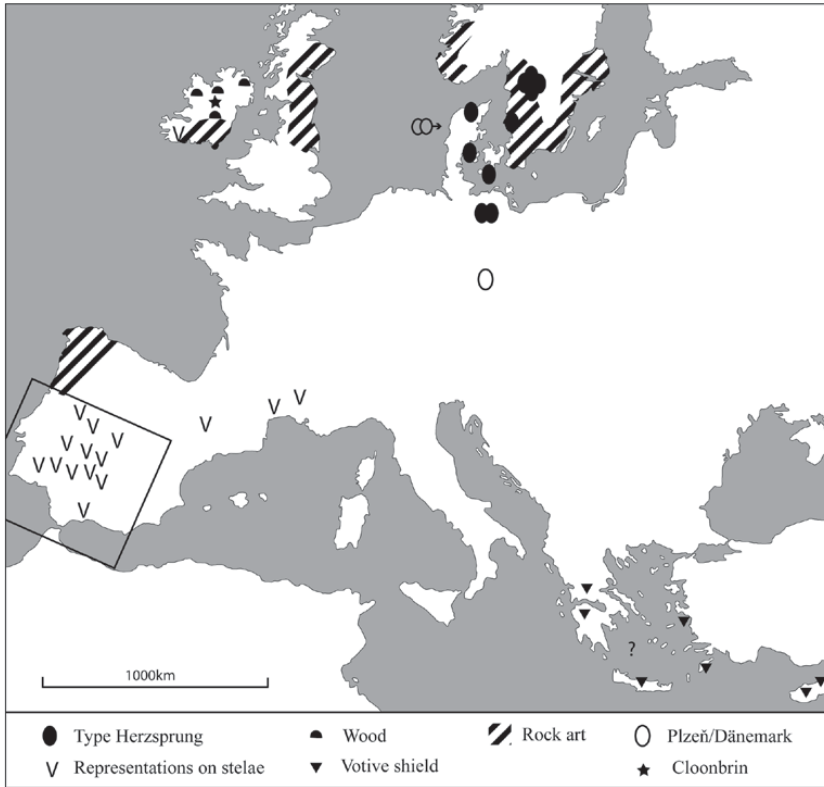


Figure 10.2 The distribution of V- and U-notched shields is evidence of a globalised Bronze Age maritime world, and rock art as an accompanying maritime ritual (hatched areas) (based on [Uckelman 2008](#). Artwork: Richard Potter).

were probably being made in the journey from their side too. In addition the landholding chiefly lineages also maintained land-based travelling networks especially in Jutland. In this way the maritime sector was never able to fully monopolise their trade.

However, the new maritime sector was able to unify and connect different maritime regions, or ‘maritories’ in the terminology of Stuart Needham (2009). It explains why certain phenomena, such as the V-notched and U-notched shields spread from the east Mediterranean to Iberia ([Mederos Martin 2009](#)), and further on to the British Isles and Scandinavia ([Uckelmann 2008](#), fig. 4). Or perhaps the origin was in Ireland, where the oldest leather shields and wooden forms/shields are found, beginning in the early to middle 2nd millennium BC ([Molloy 2009](#), [Uckelmann 2011](#)), at the same time as ‘modern’ Bronze Age warfare with swords and lances

became universal. On [Figure 10.2](#) I have added rock art to this figure to illustrate this as a specific materialisation of maritime environments.

The Uluburun shipwreck off the south Anatolian coast is a perfect example of this new globalised Bronze Age world: it contained raw materials and finished products from most parts of the known Bronze Age world – the Baltic, Italy, the Black Sea/Bulgaria, the Aegean, Cyprus, the Levant and Africa ([Pulak 1998](#)). Some of these products, such as amber, would have been traded in from the Baltic. In terms of logistics to carry out international commercial trade, the Uluburun shipwreck itself provides evidence of all of the most fundamental items: diptych for writing, seals for identification, units of measurement, weights, and marks on ingots ([Tas and Özbirecikli 2009](#)). In addition we see standardised ingot forms for easy transport, such as the oxhide ingots for copper, which have a long history ([Stos-Gale 2011](#)). This package of commercial logistics was already fully developed by the early 2nd millennium BC as demonstrated in the Old Assyrian Karum trade, and it goes back to the beginning of international trade in Mesopotamia c.3000 BC. By 1300 BC international maritime trade was in full operation, and it seems that in the Cape Gelidonya and Uluburun shipwrecks we have evidence of two different types of shipments. Cape Gelidonya illustrates the more local east Mediterranean trade in copper and tin, where raw materials in the form of oxhide ingots and tin ingots were mixed with simple finished products from the agrarian economy, such as numerous picks and hoes for sale or remelting, as well as broken pieces and casting waste and blanks, testifying to the work of tinkers and smiths ([Bass 1967](#)). Weights suggest that tinkering and trading were done in the same process. Contrary to this, the much larger and more exclusive cargo of the Uluburun wreck illustrates international elite-based trade with a wider array of prestige goods (Baltic amber, African ivory, Egyptian glass), as well as warriors to protect the ship from both Italy and the Aegean ([Pulak 1998](#); [Stos 2009](#)).

The question then becomes how much of these logistics was in use in the less developed regions of Bronze Age Europe, which provided the Mediterranean city-states with essential goods, such as amber, tin, later mercenaries and perhaps even slaves. The Uluburun ship from c.1300 BC carried an Italian warrior with a flange-hilted sword. Or more precisely, carried a flange-hilted sword of Italian type, whose owner in all probability had the same origin, as swordsmanship is closely linked to specific sword types and not easily adopted. How far back in time can we trace this internationalisation of travelling warriors?

Land-Based Networks: Traders and Travelling Warriors during the 15th and 14th Centuries BC in Europe, and Links with the Mediterranean World

The identity of traders in the Near Eastern Bronze Age is often linked to wealthy families of foreign origin that were invited to settle and bring in the goods local elites craved. The classic example is of course the Old Assyrian Karum trade ([Larsen 1976; 1987](#)), but also later we find the skills of trade in the hands of ethnic ‘foreign’ groups that through their long-distance family networks were providers of goods otherwise not attainable to local elites. However, once the traders were in place, they would often receive or develop trading monopolies in more basic resources, due to their commercial skills. Thus the Old Assyrian traders were in charge of the local copper trade throughout most of Asia Minor ([Barjamovic 2011](#)), as well as trade in wool ([Lassen 2010](#)). Such family trading houses could also operate as part of a ‘colonising’ policy to form trading emporia, exemplified by the Phoenicians, or they could be granted trading privileges as part of treaties between city-states, such as the Old Assyrian Karum trade ([Larsen 1987; 2007; Kuhrt 1998; Stein 2008](#)). Or they were migrating specialists, who brought and sold their skills as individual agents, whether mercenaries, traders or craft specialists ([Zaccagnini 1987](#)). Thus there seems to exist a historical regularity originating in the Bronze Age, perhaps earlier, that traders were defined as ethnic ‘foreigners’ thereby granting them a neutral status that gave them certain privileges, as well as constraining their activities in other ways. This is best documented in the Near East (see [Monroe 2009](#), ch. 6, for a recent discussion; overview in [Aubet 2013](#)).

I shall now explore if related conditions were at play in the European hinterlands, which provided such essential goods as amber, tin, warriors and perhaps slaves (see [Briggs-Nash 2006](#), for earliest Etruscan evidence on depictions of blonde northerners) to the Bronze Age palace economies in the Near East and the east Mediterranean. This trade was supported by central meeting places, such as Monkedonja in Istria ([Hänsel 2007](#); see discussion in [Tomas 2009](#)), the Terramare culture in the Po valley, and in south Germany the large fortified settlement at Bernstorff.¹ They reflect the

¹ Most recently a conference was held in Munich in 2014 organised by Rupert Gebhard and Rüdiger Krausse to discuss with Bronze Age specialists from around Europe the much debated finds of goldwork of apparent Mycenaean inspiration: a carved face in amber, and an amber seal with Linear B. We all had a chance to study the finds in exemplary detail, and analyses of the gold were presented. Having now studied the amber close up, it is clear to me that the carving of the face and of the Linear B are too fresh to be ancient. This also creates doubt as to the authenticity of the goldwork. Hopefully a full publication of the results of the conference

opening of a direct trade link to south Scandinavia to get amber directly from the source rather than via Wessex or the Carpathian tell cultures, which had previously been the case. This commercial shortcut directly to the source marks the start of a most remarkable flourishing of a Nordic Bronze Age culture, which suddenly became incredibly rich in copper, tin and even gold. During the next centuries south Scandinavia produced and deposited more elaborate bronzes in graves and hoards than any other region in Europe. And Baltic amber likewise ended up in rich graves in south central Europe, Italy and in Mycenaean graves (Czebreszuk 2011), as well as in the Levant (Mukherjee et al. 2008). If we consider the rate of exchange between amber, gold and copper, the economic gain for south Scandinavia by taking charge of this trade becomes easier to understand. According to textual evidence (Morkot 2007), in Egypt during the New Kingdom, the value of gold, silver, copper was calculated as 1:2:200, while in Ugarit, around 1200 BC, as 1:2:400. If, as a conservative estimate, we replace gold with amber, we can calculate its value in the Mediterranean as 2 kg amber = 400 kg copper. After a storm on a good day, an experienced amber collector can collect, with a bit of luck, up to 2 kg amber on the west coast of Jutland. Huge amounts of amber were thus in all probability exported south every year. This explains the incredible wealth after 1500 BC in bronze and gold in south Scandinavia, even if we have to subtract profits for the many middlemen on the way. Copper imported to south Scandinavia had its origin in the west Mediterranean according to lead isotope analysis (Ling et al. 2013), and mostly consisted of one dominant copper type (Liversage and Northover 1998). It suggests some form of trade monopoly, or at least the dominance of one or a few mining areas. We are thus dealing with commodity trade in copper, and high-value trade in amber, tin and gold.

It is therefore not surprising that Europe and the Aegean during the 15th–14th centuries BC shared the use of similar efficient warrior swords of the flange-hilted type, as well as selected elements of shared lifestyle, such as campstools. Linked to this are also tools for body care, such as razors and tweezers (Kaul 2013). This could hardly have come about without intense communications and practice by travelling warriors or mercenaries. Swords come in different types with different fighting styles (Kristiansen 2002; Molloy 2010). Therefore, they are not easily adapted: they are part of a system of warfare and skills that demand long-term training. They further

will appear soon. The recent finds of Minoan pottery and a seal, together with lapis lazuli, in a Bronze Age layer off the Frisian coast from the 14th century BC (Duerr 2011, pl. VII–XI), although debated, I consider likely to be authentic, as such ancient layers, even dating back to the 3rd millennium BC, are often washed free along the west coast of Jutland.

demand changes in social organisation in order to sustain the new role of warriors. It therefore seems likely that warriors were at the same time also traders, or they accompanied traders to protect them. We may therefore accept that the shared use of sword types between Scandinavia, central Europe and the Aegean during this period would also lead to similarities in the social institutions linked to warriors. This seems indeed to be the case: the dual organisation of leadership between a Wanax and a Lawagetas in the Mycenaean realm is replicated in the Nordic realm, which also copied Mycenaean material culture most closely (Kristiansen and Larsson 2005, chs 5.4 and 6.5). However, we should also be open to the possibility that this dual organisation was part of a shared Indo-European Bronze Age tradition (Parpola 2005; Kristiansen 2011).

A case in point is the constitution in the Nordic early Bronze Age of ritual chiefs of Wanax type characterised by a certain recurring set of ritual objects and symbols, and warrior chiefs of Lawagetas type with another set of recurring objects without ritual references.

The ritual chief is characterised by a special package of objects, linked to shared aesthetics and lifestyle from the Aegean to Scandinavia (Kaul 2013; Ruiz-Galvez and Galan 2013), such as campstools and drinking vessels with sun symbols at the bottom, so that the sun would rise when lifting the cup that contained mead. Razor and tweezers are often linked to this group of ritual chiefs, which share the exclusive use of spiral decoration, the symbol of sun cult and of Nordic identity. The sword would often be full-hilted and used rather for parade than warfare, rarely sharp and rarely damaged (Kristiansen 1984, for an empirical documentation of the use of different sword types).

The warrior chief on the contrary would have a highly functional, undecorated flange-hilted sword of an international type distributed from south central Europe and the Aegean to Scandinavia. It was the sword of the professional warrior, always sharp edged and often resharpened from damage in combat (Kristiansen 1984). The warrior chiefs would rarely have any of the ritualised symbolic objects of ritual chiefs, which suggests that they were denied access to this office. With ritual chiefs they shared burial in an oak coffin under a barrow, and a chiefly dress consisting of cape and round cap, both costly and socially distinctive of the free man of chiefly lineage. They also shared burial in a barrow, which is the corresponding ritual definition of 'free men', who owned cattle and farms, in opposition to those who had smaller houses without stalling for cattle (Kristiansen 2006).

Finally, we have a third group with octagonal hilted swords of south German origin, but also produced in Denmark by migrant smiths, as

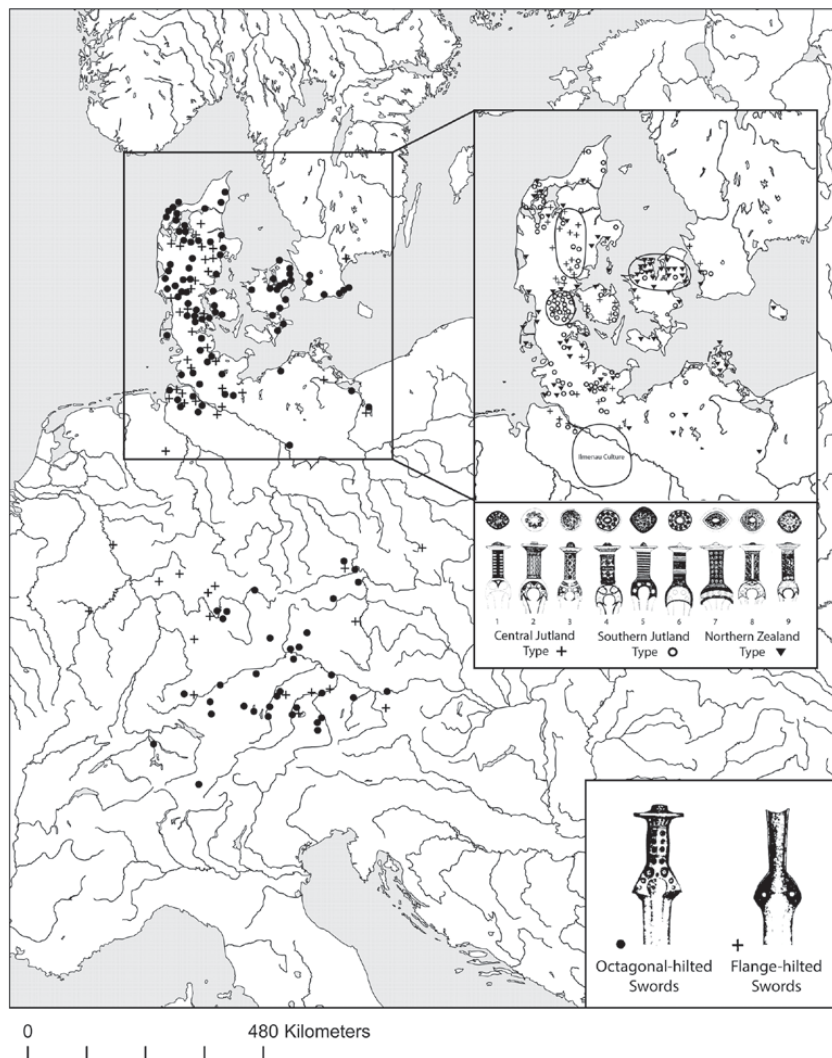


Figure 10.3 Distribution of foreign swords connecting south Germany and Denmark, versus the distribution of Nordic full-hilted swords (redrawn from Ottenjahn 1969 (Nordic swords) and Struve 1971 (flange-hilted swords); artwork Richard Potter).

they employed a specific casting method different from that of the Nordic smiths (von Quillfeldt 1995; Bunnefeld and Schwenzer 2011). Like the warriors they do not have any of the paraphernalia of the ritual chiefs, and they share the same international distribution as the flange-hilted sword. They represent a group of people who might be linked to trade and smithing (Kristiansen and Larsson 2005, fig. 107). These three groups are represented

by several hundred burials, and they serve as a prime example of Ian Hodder's dictum that material culture is meaningfully constituted. In a rather straightforward way they demonstrate that different sword types in the Bronze Age were meaningfully linked to different social and ritual institutions and social identities (Figure 10.3a and 10.3b).

Thus, the two institutions of ritual chiefs and warrior chiefs/traders have radically different distributions, and this informs us about their different roles in the reproduction of a complex set of regional and inter-regional identities, some of which formed a collective ethnicity and some of which formed a political identity. The ritual chiefs maintained the ritual and cosmological order of society, defined by a symbolic package of objects, and by the spiral decoration. It signalled Nordic identity and a shared religious cosmology, and probably also a shared cosmological origin. They were in charge of rituals, and controlled the huge corpus of religious and legal texts vital to the correct performance in rituals and vital to the maintenance of order. Therefore Nordic ritual chiefs never, or rarely, moved outside the cultural boundaries defining this 'ethnic' identity. I here define ethnic identity as a shared symbolic world of cosmological origin (Jones 1997). However, the Nordic identity displayed in the spiral style of chiefly objects refers back to a distant Mycenaean template of high culture that was not shared with other central European Bronze Age groups (Kristiansen and Larsson 2005, chs 5.3 and 5.4).

The warrior chiefs, on the contrary, were culturally defined as 'foreign', which allowed them to travel and maintain political connections outside the symbolically defined ethnic world of Nordic culture. Therefore they maintained and carried the inter-regional networks that constituted the flow of bronze and of foreign relations. They were part of a central European/north European international network, with a shared material culture of central European origin. Evidence from strontium isotope analysis of a male warrior-cemetery at Neckarsulm in south Germany showed that around one-third were non-local, but shared the same diet and lifestyle as the locals for some period of time. It suggests that chiefdoms could hire foreign warriors (Wahl and Price 2013).

Ethno-historical evidence of warrior cultures supports such an interpretation of warriors and traders on the move. Warriors often formed special group identities (sodalities) that linked them in a spatial network defined by rules of special behaviour and etiquette. This could be employed both for recruiting war bands, and for travelling to more distant chiefs to earn fame and foreign prestige, as evidenced in Africa among the Masaai, among the Japanese Samurai and a recurring feature in the literature on warriors

and warfare. However, we must assume that other groups of people could travel or even were traded as labour/slaves. Daphne Briggs-Nash's essay on travellers of the early Iron Age also has bearing upon the Bronze Age (Briggs-Nash 2007).

In this way institutions existed that took care of separate needs that were vital to Bronze Age societies: the internal maintenance of a shared cultural and cosmological world, and the external maintenance of political and commercial relations. Women achieved new social and economic status by being central to forging marriage alliances, and thus to keeping the system open (Kristiansen and Larsson 2005, ch. 5.5). Returning to the question of personhood and social identity, then, the sheer number of sword burials and the regularity they display in burial rituals and burial goods suggests that we are dealing with well-defined bounded institutions and social identities. In south Germany these networks were joined by a west Mediterranean commercial network originating in the Mycenaean world, as evidenced in Figure 10.4.

Although the finds of a Mycenaean-style gold crown and an amber seal with Linear B inscription from the Middle Bronze Age fortified settlement at Bernstorf in south Germany are now to be questioned (see note 1) (Moosauer and Bachmaier 2005; discussion in Hughes-Brock 2011; new results in Bähr et al. 2012), there is enough evidence of Mycenaean/east Mediterranean influences in the Nordic realm during the period 1450–1300 BC, such as campstools and specific forms of spiral decoration that emulated Mycenaean prototypes to document indirect trade connections (Kristiansen and Larsson 2005; Krause 2006/7). Baltic/Danish amber was the highly valued, mythical material behind these enterprises, which started during the Shaft Grave period (Maran 2004b, Hughes-Brock 2005), but became more regular and systematic with the opening of the direct trade link to Denmark via south Germany, when amber is a regular feature in Mycenaean graves (Czebreszuk 2011). Warriors and traders moved on a regular basis between south Scandinavia, south Germany and probably even further. The Terramare Settlement of northern Italy provided one such bridgehead. Here we find amber beads, but also other evidence of northern connections in sword types and pottery (Cupitò 2006, figs 37–8 and 65; Aner et al. 2011, a Boiu sword in northern Germany no. 9852 and other southern items nos. 9853 and 9855A). Figure 10.4 illustrates the extension, and some of the content of these networks, which were kept together by treaties/political alliances between the chiefdoms or rather kingdoms along the route, which in turn provided logistics and support for the traders. Dynastic marriages between chiefdoms/kingdoms along the route have long since been

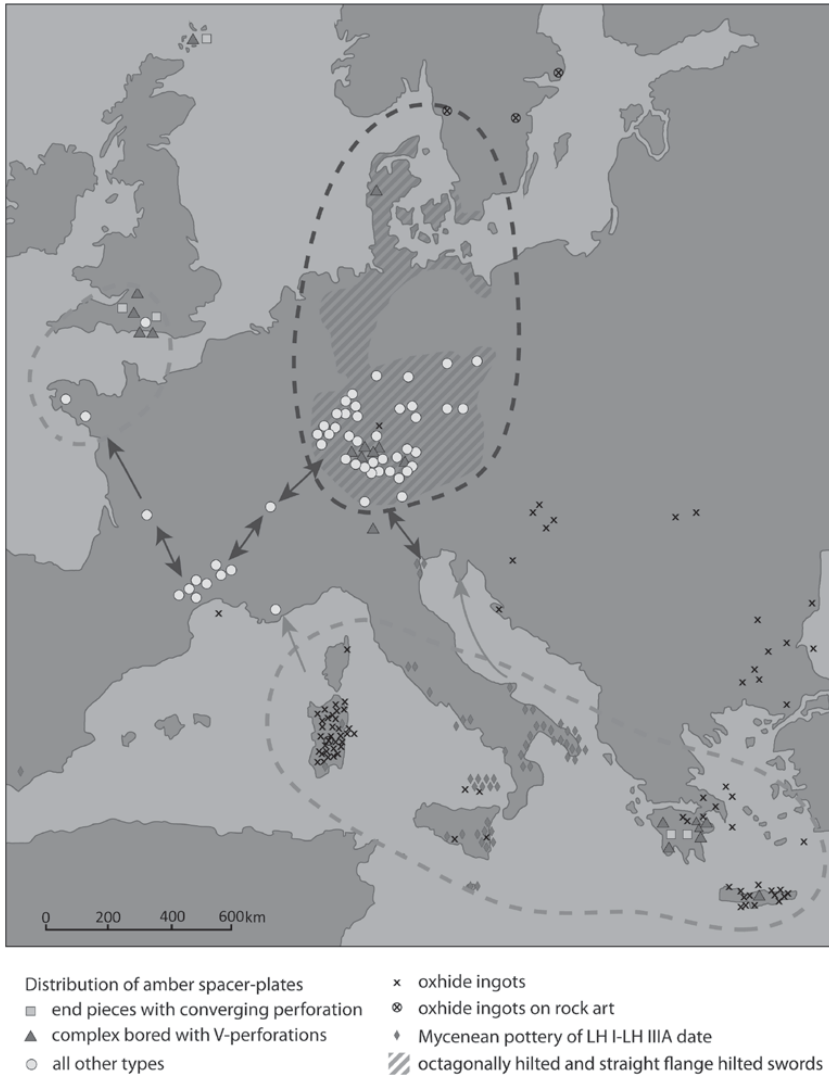


Figure 10.4 During the 15th and 14th centuries BC a maritime Mediterranean trade network was linked to a land-based trade network that connected south Scandinavia with south-central Europe and the Mediterranean (Kristian Kristiansen. Artwork: Richard Potter).

demonstrated archaeologically (Jockenhövel 1991; Kristiansen and Larsson 2005, fig. 107; Mordant et al. 2007). It provided political security for travelling warriors and traders, and although local warfare always contained a risk to the system, the benefits of maintaining stable alliances prevailed.

I have argued that in the Bronze Age there existed symbolic fields that correspond to institutions with different roles and geographical distributions. It speaks about societies that were highly complex, with a capacity to maintain parallel, coexisting forms of identity, some linked to a larger 'foreign' political/commercial world, and some linked to a more ethnic and ritual world of 'national' identity. In this the Bronze Age is not vastly different from what we know from slightly later periods, just as it provides a structural homology between the Near Eastern commercial system of specialised families of foreign traders, and a related system in central and northern Europe, albeit less complex. It explains how amber and metal could be effectively traded between the Nordic realm and the east Mediterranean, and in the process foreign prestige goods and new styles in weapons and warfare, perhaps also warriors and their social institutions, were exchanged as well. To find again a political/commercial system that was able to link Scandinavia/northern Europe to the Mediterranean, we have to wait for the Roman empire more than a thousand years later, which informs us about the complexity of the Bronze Age world. I shall now present the beginnings of the downfall of this complex world system, which introduced a Dark Age in the east Mediterranean, whereas the European Bronze Age continued for another 400 years.

The 12th-Century BC Exodus from the Po Valley and the Sea Peoples

Between 1600 and 1200 BC a remarkable civilisation flourished in the Po delta, named the Terramare culture. Through large-scale systematic field surveys and excavations Italian archaeologists have uncovered its history in great detail (Bernabò Brea et al. 1997). Settlements were well-organised, fortified villages in a fully exploited landscape of canals and waterways. So far 220 settlements are known, and the initial colonisation phase was favoured by a rather warm and dry climate with a lower groundwater level good for farming. At its height the total population reached a figure of 125,000–150,000 (Figure 10.5). The rapid rise of population, compared to other regions, and the subsequent formation of the highly organised settlement system, suggest that people from surrounding regions took part in its formation, initially from central Europe/Switzerland and Austria (Bellintani 1998, figs 1–3; Mordant et al. 2007, fig. 7; Vanzetti 2010), later from Hungary, where a similar settlement system was abandoned around 1500 BC (David 2009). Identical warrior swords of type Boiu in the two

regions testify to these connections (Kemenczei 1988, pls 13–15; Cupitò 2006, figs 32 and 34; distribution map in Dietrich 2010, fig. 4), as well as similarities in decorated pottery (compare Vicze 2011, pl. 194:1 and Kemenczei 1991, fig 92 with Bernabò Brea and Cardarelli 1997, fig. 180). But also other Italian regions contributed to the settlement expansion during this period. Pollen diagrams demonstrate a rapid clearance of forest to create a fully man-made environment during the 16th century BC, which represented a colonisation period. The new landscape, which took shape after 1500 BC when it became fully settled, was dominated by fields for cereal production, pastures for herds of sheep and a few cattle and meadows for hay production (Mercuri et al. 2006). They also grew a few legumes, such as *vicia* and *lens*. Among domestic animals sheep dominated, testifying to a developed textile production, but next comes pig whereas cattle are in the minority (Cardarelli 2004, fig. 89). Pigs are good meat producers, and they can roam in the forest and live on its products as well as on human garbage and leftovers. We should envisage a landscape intersected with stands of oaks/small forests for the pigs to roam.

However, some time after 1200 BC the whole central area of the Terramare settlement was abandoned during one or several huge exoduses: an estimated 120,000 people left (Figure 10.5). Only in the northern part of the settlement did people stay, as they had a more robust economy linked to the northern amber trade and the rise of Frattesina (Cupitò et al. 2012). It took several hundred years to resettle the central and southern delta. The question is: what were the causes of this exodus, and where did the people go? To provide an answer it is necessary first to delve a little more deeply into the dramatic 13th century BC.

The 13th century BC was a period of power balance between the Hittites and Egypt, testified in the Amarna letters (Cohen and Westbrook 2000). But the battle of Kadesh in 1274 BC between them introduced less stable conditions, as mercenaries were mobilised from surrounding, and perhaps more distant, peripheries. Mercenaries and pirates are two sides of the same coin; it depends who you work for. Central European weapons, flange-hilted swords, become frequent in the Aegean, and fortifications were erected in Tiryns and other places. The Uluburun shipwreck, with its cargo from around the Mediterranean and further away, demonstrates the ‘globalised’ nature of this period. Mycenaean, Italic and Canaanite swords identify some of the travellers. The westernising of the Aegean was thus paralleled by an easternising of Italy in terms of Mycenaean pottery, both local imitations and imports (Iacono 2012, fig. 1.2). Mycenaean and Cypriot ships had regular contacts with southern Italy, Sardinia and the

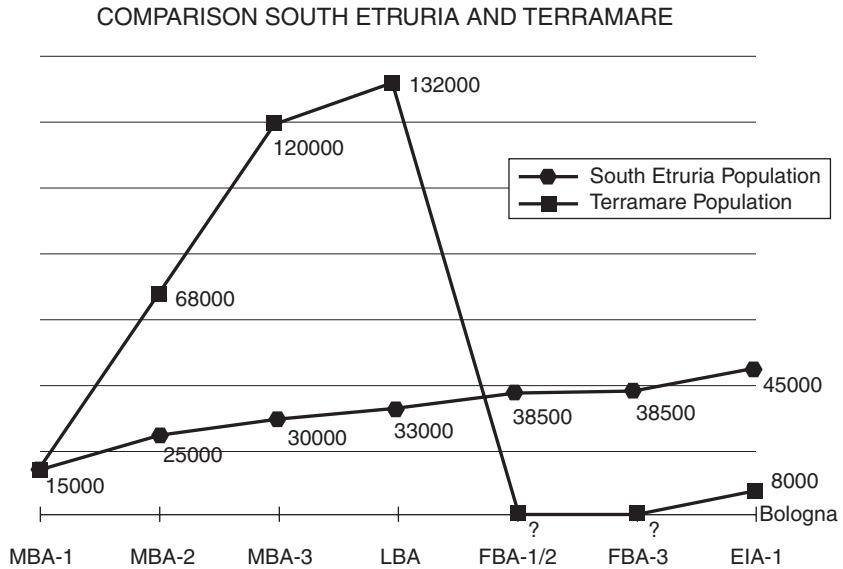


Figure 10.5 Graph showing the rapid rise and later decline of population in the Terramare culture, compared with a more normal curve (from [Provenzano 2008](#), fig. 8).

Adriatic, especially Frattesina at the mouth of the Po River, and from here contacts were close with central and northern Europe. But we can trace the Mycenaean impact as far as the Iberian Peninsula ([Mederos Martin 2008](#)).

During the 13th century the peripheries closer to the Mycenaean and Cypriot palaces were thus increasingly drawn into their realm through a mix of trade, war service by mercenaries and eventually also some dispositions of people as slaves ([Kristiansen 1998](#); [Mederos Martin 2009](#); [Bouzek 2011](#)). In the Terramare this is testified by the appearance of Mycenaean pottery and during the 13th century we find Italian-type flange-hilted swords from travelling warriors in several places in the east Mediterranean ([Jung and Mehofer 2005/2006](#); [Jung 2009b](#); [Jung and Mehofer 2013](#)). One such sword was found on the Uluburun ship, which led Susan Sherratt to see this movement as the onset of a more dynamic historical situation with less control from palaces and more private enterprises ([Sherratt 2003b](#); [2009](#)). However, others have criticised this view, and pointed out that palaces were in reality private enterprises too, just on a larger scale ([Routledge and McGeough 2009](#)). Be that as it may, we see during the 13th century an increased interaction between the east Mediterranean civilisations and the European hinterlands, from the Carpathians to northern Italy. North Italian Peschiera daggers and

early violin bow fibula used on the dress accompanied these movements and show that people rather than goods were travelling (Teržan 2007, table XXXIV). After 1200 BC these very same peripheries for reasons yet unknown started to migrate towards the centres of civilisation, at land and at sea. These latter ‘Sea Peoples’ were constituted by many tribal names, which are mentioned both by Ramses III and in preserved letters between desperate local kings:

- Ramses III in 1186 BC, before the battle with the Sea Peoples, describes their victories: “No country could stand before their arms. Hatti, Kode, Carchemish, Arzawa and Alashiya. They were cut off ... their league (the Sea Peoples) was Peleset, Tjeker, Shekelesh, Denyen and Weshesh, united lands (e.g. people)” (after Sandars 1978, 119).
- A letter between the kings of Ugarit and Alashiya shows increasing despair: “My father, the enemy ships are already here, they have set fire to my towns and have done very great damage in the country. My father did not you know that all my troops were stationed in the Hittite country, and all my ships are still stationed in Lycia, and have not yet returned?” (after Sandars 1978, 143). This letter on clay was burnt and preserved precisely because of the disaster.

We see here at work a chain of events where vassal kings send troops to help further away (in the Hittite lands), and then badly need them later when the victorious enemy arrives, as described by Ramses. So who were they? From the depiction of the sea battle at the Great Temple of Medinet Habu, we get several clues about the invaders: they were coming to settle, some of their ships had characteristic sea bird sterns, and they used horned helmets. Swan-headed sterns are well known from central Europe to the Aegean, including Italy, as the examples show (Figures 10.6a, 10.6b). Were Mycenaean and/or central European warriors among the Sea Peoples? The warriors depicted at Medinet Habu in Egypt are hybrids: the shields can be found from Denmark to Ireland, the helmets have parallels in Sardinian figurines, whereas the dress is east Mediterranean. We find the same mix on the famous warrior vase (Figure 10.6c). The Terramare populations could quite certainly have been among them, but let us first consider the archaeological evidence in more detail and the question of their exodus.

Why did people leave the Po delta around or shortly after 1200 BC? Increasing demographic pressure is one factor. Some settlements expanded from the average 1–2 hectares to 20 hectares in the late phase, when a settlement hierarchy was firmly established (Cardarelli 2009, figs 5 and 7). However, that process accelerated already from the 15th century BC

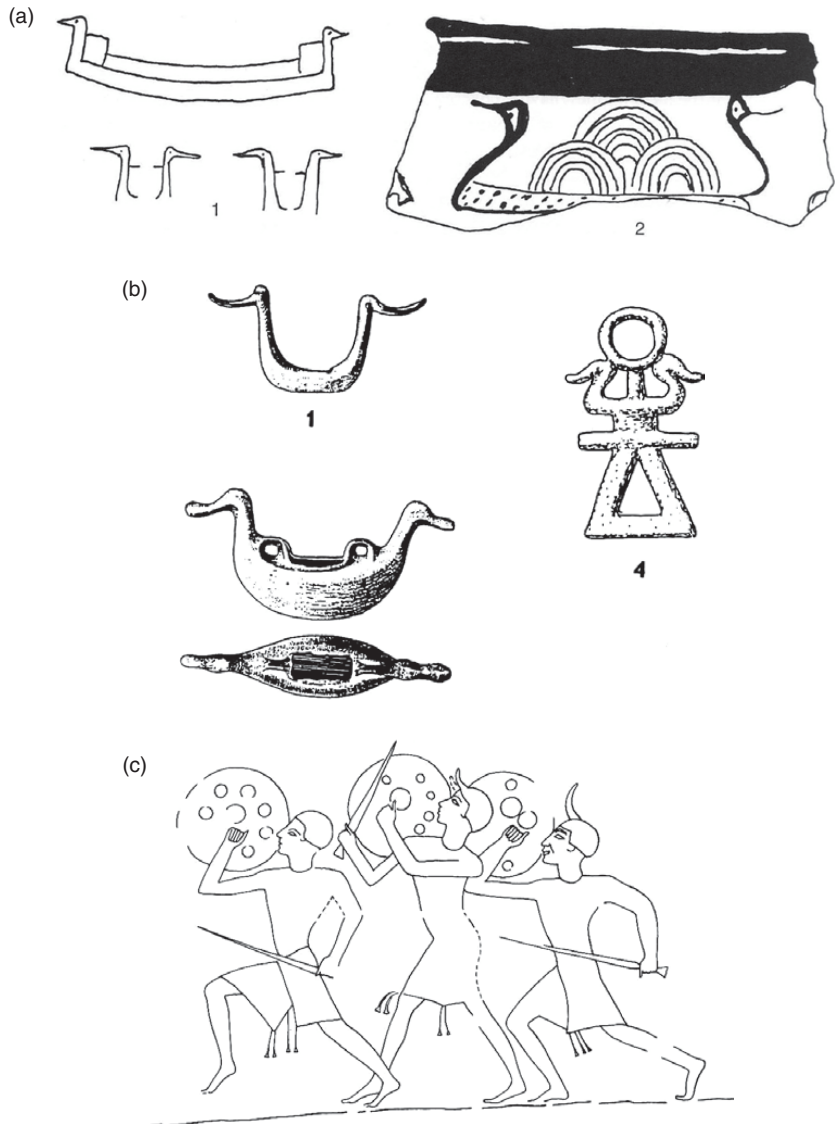


Figure 10.6 Swan-headed ships, real and symbolic from Egypt (a1) to Greece (a2), and central Europe (b). Hybrid warriors from the Medinet Habu stela (c) in Egypt.

onwards. It went hand in hand with the use of force. Evidence of Bronze Age injuries is becoming more common in modern excavations with osteological analyses. At the Middle Bronze Age cemetery from Olmo di Nogara (Verona) in the Terramare region ([Salzani 2005](#)) 16 per cent of the skeletons showed combat lesions from axes, swords and arrowheads ([Canci et al. 2005; 2009](#)). This percentage seems rather high, as many

injuries would not hit bones. We may assume frequent warfare during the Terramare occupation of the Po delta, which corresponds with extensive fortifications (Cardarelli 2009, fig. 6). Increasing competition over resources in combination with political/demographic pressure, and the onset of colder and wetter climate after 1400 BC, lasting until 1200–1100 BC, may be among the factors that finally triggered the exodus in this delicate wet area. Although a fertile environment, there is now also evidence for the cultivation of millet in the Terramare settlement (Tafari et al. 2009), also an indication of more pressure on the environment. It is in accordance with the pollen record that shows increasing signs of crisis and overexploitation after 1300 BC (Mercuri et al. 2006). However, it does not explain why nearly *all* settlements in the Po plain were abandoned after 1200 BC. Several consecutive years of drought is a well-known phenomenon also in historical times, and has been favoured by Cardarelli as a triggering factor (Cardarelli 2009, 465ff.). It is supported by recent research, which has documented a severe drop in groundwater level prior to the abandonment. As water management was an important part of the intensive agricultural regime, in part based on irrigation, such a dry, climatic event could have had disastrous effects (Cremaschi et al. 2006, supported by east Mediterranean evidence in Kaniewski et al. 2013).

A combination of all these factors probably led to a joint decision to leave and settle in areas they were already familiar with, such as the Aegean, and southern Italy/Sicily. Such communal decisions, like Caesar described it for the Helvetii, are not uncommon in connection with migrations, and they are often well-planned events with a well-known destination, as in the case of the Pueblo Societies of the American Southwest (examples in Cabana and Clark 2011). There are many indications of frequent contacts with Mycenaean people, from pottery, faience and glass beads to the increased use of grapes probably for wine during the 14th and 13th centuries BC (Mercuri et al. 2006, 55; Cupitò 2011). These regular contacts were centred among other things around the amber trade with the north (Radina and Recchia 2010), but it soon led to other forms of exchange and travels. Most recently, a hammered gold cup was found at the settlement of Montecchio in Emilia, which demonstrate the riches that were gathered based on trade (www.archeobo.arti.beniculturali.it/montecchio_re/gold_cup_en.htm). Contacts with the Aegean were thus well developed and made planning of the exodus easier. However, it is also clear that several settlements migrated to more closer regions of central Italy, which implies that the exodus was a series of planned events with different destinations (Cardarelli 2009, 487ff. and figs 9–21).

The map of violin bow fibula at [Figure 10.7](#) shows where people went because the fibula was part of dress. The early distribution is mostly to the east Mediterranean, which is supported by the distribution of dark burnished handmade pottery ('*impasto*' in Italian) of foreign, sometimes Italic type ([Figure 10.7](#)). It follows the same route and shows a similar distribution ([Lis 2009](#)). We may also note the close contacts with the northern Balkans/Hungary, which could have spurred further overland migrations (for a contextual study of Macedonia as a multicultural society during this period, see [Aslaksen 2013](#)). Thus, it seems that the Terramare migration primarily was headed towards the Aegean and Crete, and in some areas such as Achaia we find genuine Italian flange-hilted swords in local richly furnished graves, suggesting that they had succeeded in becoming local overlords ([Giannopoulos 2008](#)). The fact that Italian '*impasto*' pottery only makes up a small part of the total pottery repertoire in most settlements reflects the well-known experience that migrants and colonisers from a less developed culture rapidly adopt the superior culture, as we know from the Viking diaspora in the British Isles and France. It also seems clear Mycenaean palaces were unprepared and taken by surprise, just as happened when the Vikings first attacked the English coasts ([Maran 2009](#)).

Although the Sea Peoples were made up of many ethnic groups, there is much to support the idea that northern Italy and the Terramare exodus represents the kind of major triggering force, which in turn led to other upheavals along the way; not least if the centres were preoccupied with internal conflicts such as the Trojan War, which possibly reflected the ongoing competition between Hittite and Mycenaean kingdoms ([Mederos Martin 2009](#)). There are clear parallels to the situation in southwestern Europe 800 years later when Celtic tribes started to migrate, which set the scene for two centuries of migration and colonisation, later followed by return migrants. Thus, part of the Mycenaean populations might see better prospects in joining the Sea Peoples than staying at home. Shelley Wachsmann has convincingly argued in his recent book about the Gurob wooden ship-cart model in Egypt that it represents a Mycenaean galley, produced and buried by the Sherden and Weshesh populations of Urnfield origin from the Sea People invasion ([Wachsmann 2013](#)). It is supported by blonde hair found in tombs in Gurob Egypt, together with amber necklaces ([Wachsmann 2013](#), figs 4.25 and 4.26). Likewise, Andrea Cardarelli argues that the Terramare groups that migrated to the Aegean and Crete are synonymous with the 'Pelasgians' in later literature ([Cardarelli 2009](#), 472ff.), echoing the historical impact these turbulent decades left on oral tradition in succeeding centuries.



Figure 10.7 The distribution of violin bow fibula from 13th century onwards showing the movement of people between northern Italy, Illyria and the Aegean, Crete, and the parallel distribution of 'foreign' dark-surfaced handmade pottery (adapted from Kašuba 2008, Abb. 15, and Lis 2009, fig. 18.1. Artwork: Richard Potter).

Conclusion: From Bronze Age World System to Bronze Age Value System

I have argued how the Bronze Age saw the universal adaptation of new forms of efficient transport on land and sea, as well as a new political economy that made it possible to carry out long-distance travels and trade protected by treaties and other institutionalised forms of social and political guest-friendship. Although the European societies beyond the city-states of the Mediterranean did not adopt writing and urbanisation, they adopted the new technologies linked to trade and transport as well as organised warfare and it allowed them to interact systematically with the more complex societies in the Mediterranean. It created an economic world system of metal trade, and in the process goods and services, including tin, gold, amber,

warriors and slaves, were also exchanged from the closer and more distant peripheries to the centres. Economically it introduced a commercially based commodity trade in metal to the European Bronze Age societies that soon included gold, amber and probably also slaves and woollen textiles. New lifestyles and their accompanying institutions were adopted in the process, which reflected the assimilation of new values. More specifically:

- In south Scandinavia a Mycenaean cultural idiom was adopted, which included the dual institutions of Wanax and Lawagetas (Nordic parade swords versus international flange-hilted swords).
- For all of Europe, long-distance political treaties/alliances emerged that allowed warriors and traders to move and get logistic as well as political protection/guest-friendship. It supported a new trade economy in metal and other valuables, such as amber, gold, and tin.
- It led to the formation of new larger regional identities, such as Nordic, Tumulus, etc. which followed logically from this new international system of alliances.

A package of shared values thus accompanied these interactions. In effect it created a Bronze Age value system, which allowed traders, warriors and other people with relevant services on offer, including sailors and craftspeople, to travel between chiefly courts, and even take service at distant centres such as the Mycenaean palaces. Just as some specialists from the palaces may have found new options for their trade in the closer peripheries, as we see during the 13th century BC when not only Mycenaean pottery moved west and north but also the production of Mycenaean body armour. This increasing commercial interaction and cultural transmission between centres and peripheries has much in common with the later Roman interaction with the Barbarian, Germanic world, and in both cases it paved the way for a later Dark Age by allowing the periphery too much influence, thus tipping the balance when centres were off-guard or periodically weakened by internal conflicts. Such a commercialised world of global trade and cultural transmission sets the Bronze Age apart from everything preceding it, and marked the beginnings of the modern world.

11 | Commentary: States and Technological Mobility – A View from the West

EMMA BLAKE

Abstract

This chapter argues that political context was a determining factor in technological mobility. Weaving together the contributions to this volume and a case study of Bronze Age Italy, I trace the role of the state in facilitating the transfer of technologies, and I propose several archaeologically identifiable models for the movement of specialists.

Introduction

A theme emerging from the chapters of this volume concerns the role of the state in the spread of technologies. While some scholars address the state's involvement directly, for others, states are the implicit backdrop against which the technologies circulate. Taking the collection of chapters as a whole, the correlation between the emergence of state-level polities and the uptick in the spread of craft technologies is clear. But this begs the question, what exactly was it about early states that facilitated this technological mobility, both between them and within them? To answer this we could subsume the question within the broader topic of the economic impact of ancient states. Scholars of states (and empires) point to such features as peace and security or governmental assurances and contracts as encouraging economic growth ([Chapter 10](#), this volume, touches on this literature), although often at the expense of their subjects ([Scott 1999](#)). They also note the economic motor of the government propelling the economy, even within ancient states (e.g. [Hopkins 1980](#)), although some scholars have become sceptical about the true reach of early state administration (e.g. [Stein 1994](#)). If we think of technological mobility as an economic phenomenon, then we can insert it into the laundry list of

features of states.¹ However, technological choices are cultural as well as economic, and so framing the process in purely economic terms may lead us to miss something. Further, the political backdrops of the spread of technologies in the chapters in this volume differ widely, from Old Kingdom Egypt's vast power to the smaller scale states of Mycenaean Greece (or to use the terminology of political economies, 'corporate' versus 'network' states: [Blanton et al. 1996](#)). In fact, rather than comparing states with each other, it may be salutary to compare states and non-states. Two chapters in this volume do not examine state-level contexts at all, serving as useful counterpoints. The segmentary and middle range societies of mainland Italy in the Bronze Age offer further interesting alternatives, allowing us to query to what extent technological mobility of the sort exhibited in the Aegean and eastern Mediterranean is possible in small-scale societies. In other words, what *can't* be done outside of the state context? This chapter, then, seeks to tease out, from the other contributions, the state's direct or indirect involvement in the spread of technologies, as a step towards developing a model of states and technological mobility. From an outsider's view the spread of technologies of the East takes very different forms from that observed on the Italian peninsula in the same period. A comparison between the two areas may serve to isolate some of the factors that encouraged and, indeed, defined the mobility of the East.

The Italian Example

In Italy in the Bronze Age the populations for the most part were organised into segmentary societies, with a few chiefdoms evident in some areas (the Po Valley by the Middle Bronze Age; Etruria and coastal Apulia by the Late Bronze Age) ([Bietti Sestieri 2010](#)). The absence of states did not prevent some demographic mobility and interactions in the region: far from it. Even before the Bronze Age, there were certainly interactions around the central and western Mediterranean, as the spread of beaker pottery and Sardinian, Pantellerian, and Panicularian obsidian to the Italian peninsula and southern France attest ([Tykoc 1996](#)). In the Italian Bronze Age, particularly the Recent (RBA) and Final

¹ This may be understood as a sort of postscript to Renfrew's (1972) model of state formation, in which technology and exchange are subsystems contributing to the formation of the state, via the multiplier effect. Here the argument is that, once formed, the state worked back on those same subsystems.

(FBA) Bronze Ages (c.1350–1020 BC), bronzes, amber beads, glass beads, worked bone and ivory objects, and most famously, Mycenaean pots, were circulating around the Italian peninsula and islands (Vagnetti 1999; Vianello 2005). Before 1200 BC, most of these constituted objects moving rather than technologies: amber, bronze pieces such as fibulae and daggers, glass beads ... these were almost certainly made in one place and the traders moved with their goods while the technologies stayed put. Thus, we have artisanal ‘hotspots’ such as the settlement of Frattesina in the Veneto, a site where a robust and varied crafts industry flourished in the FBA: metallurgy, as well as industries of ivory and bone, amber, and glassy materials were all practised at the site. The glass production is particularly interesting as it is the only such centre yet known in Europe, and the chemical composition of the glass from there does not match that of the Middle East (Angelini et al. 2004). The finished products were then distributed from there. To the south, in Apulia and Basilicata, Aegean-style pots came to be made at a number of production centres along the coast, but the potter’s wheel and kiln firing do not spread beyond these centres, just the finished products (and even then the movements are limited) (Levi et al. 2006). One site, Coppa Nevigata, has yielded, quite extraordinarily, evidence of purple dye production in the form of large quantities of murex shells (Cazzella 1996, 1545–8). However, this was another technology that never took hold in Italy. In sum, technologies were introduced at select places but a condition of technological immobility prevailed.

Before seeking a political explanation for the disparity between East and West in this regard, one may look to an environmental one instead. But the environment alone does not seem sufficient to explain the contrasts in technological mobility between East and West. As Broodbank (Chapter 2, this volume) notes, many of the Mediterranean’s natural advantages are present in both the eastern and the central Mediterranean. For example, the Tyrrhenian Sea resembles the Aegean in the visibility of its land masses, its semi-aridity and its lengthy coastline and islands. And yet in the Bronze Age, not much is happening in the Tyrrhenian region. While some Aegean traders clearly visited the region, most notably either founding or stimulating the trading centre of Vivara in the Bay of Naples, the enterprises did not endure, and that site fizzled out quickly. As Broodbank notes, the differences in demographic scale may be the issue, and this could have been a limitation to technological spread in Italy more generally. Low population numbers may have also hindered state formation of course, so separating out causal factors here is a tricky business. While demography is an ultimate

causal factor underpinning longer term trends in Mediterranean history, here I would argue that differences in political complexity are the proximate cause for differences in the scale and impact of technological mobility.

Mobility and the State

The chapters in this volume span the Neolithic through the Late Bronze Age, and apart from the earliest periods, the contexts in question are state-level polities. In the case of the two chapters discussing technological mobility in non-state societies, the limits of technological changes in the early periods are evident. Urem-Kotsou's study of the evolution in pottery production in the Middle Neolithic–Late Neolithic transition in northern Greece demonstrates that the developments in pottery making were fairly circumscribed. The author argues that the changes occurred without any evidence of a resettlement of peoples, just through small-scale exchanges of finished products that local artisans were apparently inspired to copy. Thus, according to Urem-Kotsou, the observable material changes are best explained by the adoption of the new technology by local potters, rather than non-local potters settling in the area with the new technology in hand. She contends that social competition is what stimulated the Late Neolithic pottery changes, and that while some potters may have moved around, much of the innovation was local.

This scenario involving the voluntary and diffuse localised adoption of ceramic technologies resonates with the spread of Apennine style ceramics in the later Middle Bronze Age in Italy, where broadly similar decorations and forms across much of the peninsula belie regional distinctions in relative densities of particular design elements and formal features (Macchiarella 1995). These regional differences are evidence of local potters at work. As these are hand-built pots the technology concerns form and decoration, both of which presumably could be copied locally from observation of finished products alone. The impression therefore is of potters working entirely independently and only a few of the pots moving. The spread of these technologies was easily achieved and, in the case of Italy, had little long-term impact, as the implied unity of the pot styles did not last into the next period. This copying of simpler technologies from finished goods requires no state-level context to occur.

Georgakopoulou's study of smelting technologies in the EBA southern Aegean highlights just how complex the material patterning of technological spread can be. Here, the variation in furnace types does not align

with any evident social boundaries, and it seems that there were diverse contemporaneous practices – perhaps communities of practice – operating. Georgakopoulou suggests that the mobility of the metalworkers was seasonal, visiting the ore sources and smelting sites in punctuated moments which would have prevented anything more than brief encounters between metalworkers of different communities. This lack of sustained long-term interaction encouraged the maintenance of diverse metalworking traditions even though the groups were not wholly isolated from one another. Unlike ceramic technologies, in which finished objects can be shared and copied, furnace types would presumably require some extended training to replicate, as well as some demonstration of them in use as proof of their worth. This sort of technological transfer is a far more involved undertaking than the copying of pottery decorations, therefore. In this pre-state context, where the adoption of new technologies would have been optional and would have meant going against prevailing practice, why bother? Again, Bronze Age Italy offers a useful parallel. The copper mining and smelting technologies in northern Italy in the Recent Bronze Age did not spread to other areas, notably to Tuscany where metalworking was taking off, even though finished products from the north did circulate widely. While this has been interpreted to mean that the technologies had been carefully restricted while final products circulated freely (Pearce 2000, 108), it may be a case akin to the EBA southern Aegean, with communities of practice in a non-state context displaying conservatism in their craft.

With the case studies involving state contexts, the technological changes look different in both form and scale. Bevan and Bloxam examine stone-working in the Aegean and Egypt in the Bronze Age. They posit that the technologies of stone-working moved with people around the region, and they draw attention to variations in the circumstances of learning for artists working at all stages in the stone-working process, from highly specialised attached workers to apprentices to all-purpose masons. They suggest that it is not possible to make a blanket statement about the nature of the transmission of stone-working technologies, as the requirements for training in these tasks vary enormously, and instead the people involved should be analysed in a tiered fashion from highly trained attached palace workers to generalised labourers. Their emphasis on the role of apprenticeship is particularly important, as the years of training required to become adept at stone-working eliminate the possibility of transmission of the technologies via casual seasonal encounters or unguided copying of finished products. Documentary and archaeological evidence offer convincing examples of the palace-driven transfers

of stone-working specialists between kingdoms (e.g. Amarna letters) or into the hinterland (in the case of Neopalatial Crete) as gifts or loans, but there were also cases of craft-working communities – kin groups or otherwise – operating with some autonomy or agency. Nonetheless, as Bevan and Bloxam describe it, the role of the state was pervasive. The Widan el-Faras quarry's use in the 3rd millennium BC demonstrates the impact of the state: worked periodically for material for some of the major Old Kingdom pyramids, both the impetus for quarrying and the transport infrastructure at the site were provided by the state. For example, a paved road (the oldest known in the world), linking that quarry to river transport 11 km away demonstrates state involvement. Similarly, the authors discuss the intricate network of roads extending from the Aswan quarry, pointing to a stone-working system underpinned by a highly developed state apparatus. The stone-working communities lived along the road, and thus even the semi-autonomous communities of practice were in large degree shaped by state infrastructure. Importantly, the authors argue “that imported specialist knowledge from elsewhere in the Egyptian state relates strongly to these technologies for road building and logistical organisation and it is in these contexts that we should situate any possibilities for horizontal transmission of technological know-how between local and non-local specialist groups”. With this we are a long way from the informal voluntary adoption of some new craft techniques we may observe in pre-state contexts. We can infer therefore that the state could and did override any inherent conservatism of the craft workers. The structure of technological mobility was now complex and tiered, and the scale, in terms of the people involved, was exponentially bigger.

In Bronze Age Italy there is nothing comparable to the Egyptian state involvement Bevan and Bloxam describe. Any craft technologies that we can trace involve seemingly no more than one group or class of artisans. The potter's wheel, for example, is introduced from the Aegean to a handful of coastal sites in the Late Bronze Age, and the results are the so-called Aegean-style pots made at several sites in southern Italy and the islands (Bettelli 2002). However this technology was transmitted, it was an isolated craft, not an entire system with diverse personnel imbricated within its structure. Further, the potter's wheel in Italy made no inroads as a device into communities outside the southern coastal strip, and so the technology stagnated and virtually disappeared before being reintroduced in the 9th century BC, probably by a new wave of foreign potters (Boccuccia et al. 1998, 258). It seems that the spread of this technology was dependent on the agency of the local potters, and they resisted it.

Kiriatzi and Andreou similarly observe the role of the Mycenaean state in the overseas spread of Mycenaean-style pottery, and they situate the resettlement of Aegean potters in northern Greece and Italy within the context of an outward-looking Mycenaean society. This is particularly interesting as Kiriatzi and Andreou note that pottery is now understood to have been a low-value good and a largely decentralised industry, allowing for entrepreneurial potters to operate largely independently of the palaces. Therefore, even when the state was not directly involved, technologies could move if the state afforded the possibility for material gain by doing so. The state's role did not extend to the receiving end of this new technology in Italy anyway!

Glassworking, in contrast to pottery, was a technology that seems to have been highly dependent on the state. Shortland notes the extreme uniformity of Late Bronze Age glass in the places it was found, with the same major elements in all cases, while any differences in trace elements emerged unintentionally from regional differences in geology. This is fairly convincing evidence of a single technology spreading rather than independent local innovations. Apparently the glassmaking technology did not spread to Greece in this period, where to date there is no evidence of locally made glass, and instead glass seems to have been imported in ingot form, from Egypt primarily, and then worked in Greece. Shortland also observes the cessation after 1250 BC of glass production, as inferred by the complete disappearance of glass from then through the end of the second millennium BC. What changed? The collapse of the state systems. The unitary nature of the glass-making technology and its subsequent demise speak to top-down involvement in the movements of this craft, rather than their organic spread, where one would expect some local variations to arise. This technological spread may have been facilitated by writing and by standardised weights and measures that may emerge in state-level societies (Schon 2014). In Bronze Age Italy, those objects displaying standardised manufacture were, quite simply, all made in one place and then distributed. In the west there is some production of glassy faience beads from the MBA on, with particular quantities in the FBA, whose compositions change over time, but were probably only made at one or two centres (Bellintani and Residori 2003). As noted above, true glass in Italy was manufactured at just one site, Frattesina (Angelini et al. 2004). Similarly, in the FBA, Frattesina-style ivory combs were probably made at the northern craft centre of Frattesina (Bettelli et al. 2006). In fact, over time in Italy the trend in metallurgy, ceramics and other crafts was toward regionalism, in the Final Bronze Age, not towards a standardisation in technologies and styles (Bietti Sestieri 2010)

But the state isn't sufficient to explain the patterns in all cases, as Nikolakopoulou and Knappett make clear, advocating a multi-scalar approach. All the authors in this volume argue to varying degrees that craftspeople from the country of origin must have come to settle in the receptor region. Even if the particular mechanisms for these movements of peoples require theorising, at the level of individual media and specific contexts the theory is entirely unproblematic. The complexities arise when combining these individual cases of technological transfer into a bigger picture of broad suites of technologies and material culture styles spreading, as Nikolakopoulou and Knappett explore. They focus on the complex phenomena embedded in the term 'Minoanisation', noting the interplay between local change and Cretan influence on Thera and elsewhere. The authors, observing the "piecemeal uptake, maintenance of local traditions, and regional variations" that characterise the spread of Minoan culture beyond Crete, reject a monolithic colonisation explanation. They recommend looking at the phenomena from multiple scales: the individual, the community and culture. Perhaps even more than the standard unidirectional acculturation or colonisation models, the new focus on intersecting communities of practice makes sense only within a society where the state is not a backdrop but an active player. The mobility of skilled artisans of various types, apparently going back and forth between Crete and Thera, was underwritten by a state apparatus that encouraged or even engineered these visits. In other words, this is not a simple bottom-up process arising from cultural interconnections: this may be top-down. As Nikolakopoulou and Knappett note, "it is hard to avoid the conclusion that the rise of Knossos as the dominant centre must be in some way responsible". Thus when we see a slew of practices spreading that cannot be attributed to one single event, we may infer that the back-and-forth entailed a state authority.

Boileau considers the presence of locally made Aegean-style pottery outside of the Mycenaean region but under very different circumstances from those Kiriati and Andreou describe. At the end of the Bronze Age in the northern Levant, at the time of the palatial collapses, local Aegean-style pots, as well as Handmade Burnished Ware, are common finds at the site of Tell Kazel. Boileau suggests the likelihood of small enclaves of foreigners from the Aegean living in this and other northern Levantine towns, perhaps displaced by the upheavals further north. Boileau explores the archaeological signatures of mobility and the possibility of determining the social identities of the migrants. Her explanation, that small groups of foreign potters settled at Tell Kazel and elsewhere in the northern Levant,

echoes that of Andreou and Kiriati, but these resettled potters had moved for very different reasons. In her case study, the small group of foreigners were not training others but kept to themselves. This is an alternative scenario from the seepage of technologies that occurred with ‘Minoanisation’, for example. It is not enough to just move people from one place to another to have technological exchanges: they need to be interacting closely with each other, as Nikolakopoulou and Knappett note, and this interaction may be facilitated by the state.

Modelling the Movement of Specialists

Many of the case studies reinforce the notion of specialists transmitting technologies by moving to a receptor region. Resettled artisans constitute a viable hypothesis to explain how a receptor region could come to learn a new technology, but this in turn begs the question, what were the circumstances of the movements of these craftspeople? Were they operating independently or under the aegis of a higher authority? Would the transplanted craftspeople stay permanently or just long enough to get the industry established, with local apprentices? For glassmaking, the evidence points to a restricted spread, and perhaps constitutes a case of the palace-controlled movement of artisans between courts, what we may label the ‘forced-transfer’ model of specialist mobility. This model would fit the highly specialised stone-working technologies that Bevan and Bloxam suggest were practised by trained workers attached to the courts. In the case of pottery, however, whose practitioners need not have been court-based, the circumstances are less clear. In the Tell Kazel example that Boileau discusses, the context, a period of upheavals, suggests migrant ceramicists acting on their own, having perhaps fled trouble elsewhere. In the Macedonian case Kiriati and Andreou discuss, the circumstances and motives behind the apparent immigration of Mycenaean potters are difficult to ascertain. It is worth thinking about other possible models for explaining the movements of these specialists.

One model, which we may label ‘itinerant entrepreneurial’, posits that the craftspeople were moving independently of any higher authority, and that they did so peripatetically, not settling for long in any one place. This is the model of the Bronze Age smith described by Kristiansen and Larsson (2005). The authors explain the rapid spread of bronzeworking techniques across a swath of land encompassing most of Europe in the Early and Middle Bronze Ages by the movement of individual smiths covering long

distances and transmitting these technologies. A similar model has been posited to explain Cypriot metal objects in Sardinia at the end of the Bronze Age. In the 12th and 11th centuries BC, Cypriot-style metal objects turn up in considerable numbers on that island. In the absence of any provenancing other than stylistic, that they are imports cannot be confirmed, so we can at best observe that the objects are Cypriot in style. These objects include weapons such as daggers, accessories and furnishings such as mirrors and stands, and particularly intriguingly, the complete complement of smithing tools: hammers, tongs and shovels (Lo Schiavo 2003, 159). These tools, together with the Sardinian adoption of Cypriot metalworking techniques such as casting moulds, suggest that something more was going on than simply Cypriot traders visiting Sardinia. Lo Schiavo (2001, 141) suggests that Cypriot metalworkers may have stayed on the island seasonally, leaving behind the products of their knowledge but no material traces of a permanent presence. Without supporting evidence this theory is necessarily highly speculative. Whatever the nature of the Cypriot influence, the technology was transmitted and the Sardinian smiths branched off on their own to produce a vibrant repertoire of objects (Lo Schiavo 2003, 159).

This sort of itinerant entrepreneurial model need not occur in a state-level context. In fact it may be somewhat antithetical to the notion (perhaps overstated) of the authoritarian Bronze Age state. Indeed, palatial centres with attached craftspeople at home make this cheering and romantic image of the entrepreneurial smith rather unlikely. Only after the Bronze Age collapse does such a model seem possible, as in the Sardinian case mentioned above. Prior to the collapse the model may work on a local scale to explain the intra-regional spread of technologies, but is not attested at the inter-regional scale.

Alternatively, rather than itinerant specialists one may posit single events of migration, the ‘immigrant-artisan’ model. This model features prominently in Greco-Roman literary traditions, in which a male heroic type flees or is exiled from home and sets up shop somewhere else, introduces new technologies to a receptive native populace, marries a local woman and settles down. The story of the introduction of clay working (usually interpreted to mean terracotta sculpture rather than pottery) to Etruria is told along these lines, with Damaratus, a Greek from Corinth, fleeing a tyrant in the 7th century BC and then settling in Etruria with a talented entourage. Pliny gives the account: “Damaratus, on taking to flight from [Corinth] and settling in Etruria, where he became father of Tarquinius, who was ultimately king of the Roman people, was accompanied thither by the modellers Euchir, Diopus, and Eugrammus, by whose

agency the art was first introduced into Italy” (Pliny, *Natural History* 35.12.43; transl. J. Bostock). Myth or otherwise, this model has seeped into the scholarly consciousness enough that it is generally accepted that Greek potters, tomb painters and the like were living and working in Etruria from the 7th century BC on, and were doing so independently of any state involvement. As Otto Brendel notes of the Damaratus story: “In its own semi-legendary way it testifies to the presence of immigrant craftsmen in Etruria during the seventh century, which seems reasonable” (Brendel 1978, 95).

Supporting evidence for this model in the Etruscan case comes from some of the Greek-style pottery in Etruria, locally made but bearing pot painters’ names that are Greek. An example is the Aristonothos krater from the Etruscan city of Cerveteri, and dated to the mid-7th century BC. The name translates as ‘best bastard’ and one scholar suggests this may imply a “servile or renegade background for the artist” (Spivey 1997, 56). This fits the image of the immigrant artisan as either a marginal or rebellious type, a ‘self-made man’. Spivey goes on to speculate of Aristonothos’ coming to Etruria: “As long as he was armed with technical ability and not colonising ambitions, he was *persona grata*. Eventually he may have taken on native apprentices” (Spivey 1997, 58). The start of tomb painting in the Etruscan city of Tarquinia is similarly attributed by modern scholars to East Greek artists fleeing the Persian invasion of their homeland during the late 6th century BC (Spivey 1997, 58). While the subsequent explosion of tomb paintings in Tarquinia demonstrates the adoption of the technique by local artists, the catalyst is thought to have been the arrival of immigrant artists.

In the Bronze Age the immigrant artisan model has found less purchase than in the classical world, at least before the palatial collapse. In this respect Boileau’s case may fit this model well. In the Bronze Age in the Aegean and eastern Mediterranean, however, it is difficult to posit craftspeople, especially those involved with luxury objects, operating independently of state authorities, whether as itinerant workers or permanent migrants. The standard model is that these workers and their industries would remain attached to their home base. Even if in the case of the Mycenaeans the traditional palace-centred economic model has come under some criticism of late (see papers in Galaty and Parkinson 2007), the new shrunken palace economies still included skilled artisans. It is difficult therefore to imagine authorities letting these valuable technologies go voluntarily, although exchanges of artisans between courts are known. Perhaps for the palaces, one large payout in the purchase of a craftsperson (say, a Nuzi glassmaker bought by an Egyptian authority) would have made more economic sense than the risky

transfer of finished items over a long period of time. Or, economic calculations aside, diplomacy may have called for such gifts to keep the peace, along with, in the case of the glassmaking, a pledge not to attempt to undercut each other's domestic market. The glassmaking and ceramic production were particularly well-suited to the movement of craftspeople because the raw materials would have been readily available in receptor regions.

Another explanatory model would be an 'overseas apprenticeship' model, in which the receptor polity sent craftspeople to the region of origin for training, so that the technological spread that we observe is the result of people moving in the opposite direction, to the source, and then bringing their skills back home. In that case we must imagine a situation of great sustained trust, with the best learners selected and sent as apprentices to the other region with a promise of safe return. While possible, this model seems less likely for the cases in this volume. Archaeologically one would expect to find foreign craft technologies made in a local style. In any case, these are just some of the possible human roles in technological transfer, but apart from the itinerant specialist, a state-level context seems fundamental.

Conclusions

To conclude, the movements of complex technologies may take various forms, but we can generalise enough to say that those technological transfers that stick and have the most impact come not from someone passing through briefly and moving on, but from a period of sustained interactions between willing tutors and learners (pace Kristiansen, [Chapter 10](#), this volume, and [Kristiansen and Larsson 2005](#)). While I agree with Kristiansen that goods and peoples moved around in the Bronze Age, even in Europe, to an extent unknown in prior history, the movement of technologies was a trickier proposition. Travelling was only a part of the story, as the travelling specialists then had to be able to connect with their counterparts in the new place and have a common goal of passing and receiving information. Palace authorities must have provided the impetus for innovation that was lacking in the craft communities, and then underpinned that drive for technological innovation with the necessary infrastructure and assurances. In short the state provided the foundations on which to build the interactions that were already a feature of the ancient Mediterranean into something enduring and important.

Commentary: On Fluxes, Connections and their Archaeological Manifestations

OLIVIER P. GOSSELAIN

Abstract

The current chapter discusses the contributions included in this volume, focusing on four key aspects of the author's relevant ethnographic research in Africa: 'connectivity', 'mobility', 'community' and 'utility'.

This was not an easy piece to write. Indeed, what kind of 'response chapter' can you think of when you not only agree with the ideas and research directions developed by the editors of the volume, but also with much of the analyses and interpretation of the contributors? And how do you engage in dialogue when the bulk of discussions centre on regions and time periods completely unfamiliar to you? As I struggled through various versions of this chapter and resisted the temptation to develop my own case study, it became obvious that the best I could do was to comment freely on some key concepts running through the volume. Four of them caught my attention as they related to aspects of my own ethnographical research in Africa: 'connectivity', 'mobility', 'community' and 'utility'. In the following sections, I will discuss them in turn, in the hope of enriching the collective reflexion and, when possible, proposing new research directions.

Connectivity

Most contributors to the volume focus on local processes of cultural (re) construction. In so doing, they shift the scale of analysis from whole populations and 'cultures' to persons and individual artefacts and, above all, place the emphasis on 'connectivity' instead of specific spatially oriented and hierarchical patterns of relationships. This shift is not only in phase with the propositions made by Kiriati and Knappett in their introductory chapters, but also interesting in several respects. First, the concept of connectivity

is liable to encompass multiple situations of encounters between things, ideas and people, irrespective of the direction, scale and intensity of fluxes. Second, it underlines the geographical dimension of mobility, as we will see below. Third, it introduces a temporal dimension that is inevitably missing in migratory models of explanation that view population movements as single events. An important difference between ‘migrations’ and ‘connections’ is indeed that the former involves a spatial translation, and hence a temporary or permanent rupture with the place of origin, while the latter suppose ongoing relations and circulation. In fact, migrations only create connections in specific circumstances – as in the case of ‘circular’ or seasonal migrations, when migrants temporarily settle in distant communities for economic reasons and come back after several months (e.g. [Rain 2001](#); and see next section) – or when involving individuals who are both keen and able to maintain social ties with their place of origin.

But connectivity is not an explanation in itself. It is just a prerequisite for the circulation of things, ideas and people. When Kristiansen writes that the development of the maritime sector “explains why certain phenomena such as V-notched and U-notched shields spread from the east Mediterranean to Iberia ... and further on to the British Isles and Scandinavia”, I am afraid that he pushes things a bit too far. Such diffusion may have been facilitated (or even made possible) by the development of navigation techniques, but the latter do not ‘explain why’ specific items were locally adopted. As illustrated throughout the book, connectivity should best be conceived as a structural framework that combines *nodes* (villages, towns, markets, trading posts, ports), *vectors* (roads, valleys, rivers, maritime routes) and *means of travelling* (humans, animals, ships). Such structural frameworks only offer *possibilities* for the circulation of people and cultural items. They do not force or lead them mechanically to do so. In fact, it is probably safer to consider that most elements or individuals do not (and will not ever) benefit from the many travelling opportunities offered to them. Even in our modern, hyper-connected world, what is our actual experience of the web of relations to which we are associated? To use a hydraulic metaphor, we should avoid considering connectivity (or networks in general) as a system of pipes, through which water would automatically flow once a tap is opened. Unless, of course, one believes in biology-inspired models of diffusion where cultural elements are thought to propagate through mere contacts, thanks to the competitive advantage of their intrinsic qualities (e.g. [Shennan 2002](#); [Sperber 1996](#)). This is clearly not the case here. On the contrary, most contributions contend that the circulation of things, techniques and people is the product of historical circumstances, in which

social relations and representations, economy and the organisation of craft practice – to point out only a few aspects – play a leading role. They act both as filters and driving forces, as we will see in the following sections.

As a geographical phenomenon, connectivity is also the product of historical circumstances. For example, long-term connections across the Mediterranean partially developed through the exploitation of raw materials such as obsidian and metal ore. The unevenness of their geographical distribution was a “promoter of interaction and craft mobility” as stressed by Broodbank, and the reason why specific locations – notably islands – became frequented at regular intervals and, for some of them, subsequently integrated in commercial networks. Connectivity, in other words, partially developed in close relation to technical practice. Besides allowing new interactions and the circulation of other categories of items, an interesting aspect of such development is the possible persistence of associated practices when the initial reasons for frequenting specific sites no longer exist. As suggested by Georgakopoulou, for example, southern Aegean EBA smelters processed metal ores imported from distant islands on places that they had formerly also frequented for raw material exploitation. Initially chosen for their geological properties, such sites changed status but remained embedded in the space of experience of EBA smelters. Another striking phenomenon is that some smelting areas were frequented by groups of artisans with distinct technical practices. These groups operated on several sites across the southern Aegean, where they were able to transmit their knowledge and put them into practice. But inter-group exchanges of knowledge did not occur, even when artisans exploited similar mining or smelting areas. While not directly related to the historical dimension of connectivity, such situations remind us that it is not just because there exists a possibility of transfer that a transfer actually occurs.

Mobility

Many contributions make explicit references to the mobility of craft specialists and their impact on local practices. Evoked in turn as ‘travelling’, ‘itinerant’, ‘mobile’, ‘migrants’ or ‘immigrants’, those concerned obviously had distinct socio-professional profiles, motivations, and life trajectories. Following Bevan and Bloxam, a first distinction must probably be made between artisans whose mobility was controlled by a political power, and those who moved independently and deliberately (e.g. the entrepreneurial Mycenaean potters described by Kiriati and Andreou). As Blake discusses the role of states on

artisans' mobility in her response chapter, I will focus on the latter. Let us keep in mind, however, that even in situations of court-to-court transfers of specialists a possibility exists for technical knowledge to be transmitted informally to the local labour force, as shown by Bevan and Bloxam. Knowledge circulation, in other words, is less easily controlled than people circulation – a fact hardly surprising when considering the modern world.

Also, political control is only one of the many forms of power relationships liable to affect artisans' mobility. In her interpretation of the small-scale and gradual dissemination of technical innovations in Macedonia, for example, Urem-Kotsou suggests 'marriage' and the 'avoidance of conflict' as the likely causes of such dissemination. Many ethnographical studies show indeed that post-marital relocations play a crucial role in the spatial distribution of technical traditions. However, movements related to marriage are anything but random. In most socio-historical contexts, the choice of both partners and post-marital residences is highly regulated, as are the socialisation processes to which newlyweds are submitted. A good, albeit extreme, example comes from African societies where craft activities are in the hands of members of caste-like structures with strict endogamy rules. Given the low demographic importance of such groups, the quest for marriageable partners may lead caste individuals to travel further than non-caste ones and to cross main social boundaries (e.g. [Haaland 1978](#); [MacEachern 1998](#)). Patrilineal and matrilineal kinship systems also seem to weigh differently on the spatial mobility of craftspeople, and hence on the dissemination of knowledge ([Livingstone Smith and Vander Vecken 2009](#)). As for movements related to the 'avoidance of conflict', they must obviously have been important at certain moments in time and in certain areas, as suggested by Kristiansen. But here again, it is most probable that conflicts affect people differently depending on their social identity, status, religion, wealth or gender. Who moves, under which circumstances, to go where and for what length of time is largely a matter of pre-existing socio-historical conditions (e.g. [Scott 2010](#)). Besides, spatial mobility in times of conflict does not only concern people fleeing to more secure areas, but also the forced relocation of captives. As the latter are frequently associated with production activities and are sometimes specifically targeted for their skills, Cameron (2011) has recently urged archaeologists to examine their possible role as 'agents of culture change'. Surprisingly – given the importance of slavery in Mediterranean history – none of the contributors to this volume pays attention to them (except for some passing mentions in Kristiansen's chapter). Is it because of their poor archaeological visibility? Or because we still have difficulty considering marginality and bottom-up processes

of culture change in our archaeological reasoning (but see Kiriati and Andreou)?

Turning to the deliberate mobility of craft specialists, I want to focus on these ‘entrepreneurial’ migrants evoked explicitly or implicitly by Bevan and Bloxam, Nikolakopoulou and Knappett, Kiriati and Andreou, and Boileau (although her use of the generic term ‘migrant’ is somewhat confusing in that regard). This category of mobile artisans concerns people who relocate temporarily or permanently in areas where they find good economic opportunities. Using their own techniques, tools – and, sometimes, raw materials – they not only produce artefacts in distinctly foreign ways, but may also contribute to the dissemination of foreign traditions through the training of local individuals. Unsurprisingly, there exists much variation in the scale and rate of migratory movements, the choice of destinations or the relationships with host communities.

This diversity has recently been illustrated by Ramón (2011), who examined ethnographical and historical data from northwestern Peru in an effort to build a typology of seasonal migrant potters. He identified six situations (Ramón 2011, 163–9): (1) “the cluster”, in which potters settle in distinct communities from year to year, within a given territory (defined as a ‘web of places’), timing their sojourns to coincide with local harvesting periods; (2) “the favourite one”, in which potters frequent the same villages or areas throughout the years, choosing destinations because of the existence of large markets and/or the importance of agricultural production; (3) the “inter-communal peonage”, in which foreign potters are hired in pottery-producing communities, either because demand rises (e.g. before local festivities) or because they work faster; (4) the “settled swallows”, in which groups of potters working in workshops and specialising in the making of specific vessels circulate between home and host communities for a period of time until relocating permanently (a situation also documented in Crete by Voyatzoglou 1974); (5) the “flock within a flow”, in which potters travel along other seasonal migrants at harvest time, settling in big coastal haciendas in need of workforce; and (6) the “herders potters”, in which the craft is practised as a secondary activity by pastoralists who circulate between different ecological zones throughout the year.

From a technical point of view, it is interesting to note that Peruvian ‘swallow potters’ usually travel with their own clay when temporarily relocating in non-potting communities. Fuel is the only material collected locally, which may force potters to develop different firing strategies or find equivalent materials when unable to procure their usual ones. Their tools – and especially the ceramic plates used as pivoting supports – are the main

material 'signature' of their presence. When settling in pottery-producing centres and being involved in local workshops (situation 3), visiting potters produce 'blended' artefacts, with the shape and decoration defined by the host community, while manufacturing techniques are those learned and practised in their home community (Ramón 2011, 166).

Ramón points out several other interesting elements. Notably that migrant routes and destinations often developed within a web of long-term inter-communal and inter-regional relationships unrelated to pottery making. Also, that the development of road infrastructure and motorised transport has increased the range and number of destination areas, or that the selection of host communities is sometimes influenced by the presence of relatives who not only inform potters on local demand but provide lodging. Curiously, the sole example of technical transfer documented by Ramón concerns situations of permanent relocation; that is, craft contexts that are no longer associated with, or structured by seasonal migrations. This would fit with Kiriati and Andreou's hypothesis that, in central Macedonia, Mycenaean pottery was initially produced "by 'foreign' mobile/travelling potters" and that "its production was increasingly associated with settled, non-mobile potters".

It must be stressed that the different situations described by Ramón do not necessarily correspond to distinct socio-historical contexts. Judging from my own ethnographical observations, I would mostly view them as possible stages in regional dynamics or individual life histories. This seems to be the case in the male potting communities of south-central Niger (Gosselain 2016). Initially founded by refugees fleeing religion wars and slave raids in present-day Nigeria, these communities maintained social and economic ties with their home region throughout the 19th century. At the onset of colonisation, changing economic circumstances led some north Nigerian males to appropriate female pottery techniques and to specialise in the production of standardised water bottles. Despite a high demand, the local market was progressively saturated, which led potters to find new market opportunities in neighbouring regions and to engage in seasonal migrations. This is how the male pottery tradition developed in Niger, through both the back and forth movements of north Nigerian migrants and the permanent relocation of some of them. Pre-existing inter-regional relations, it must be stressed, were not the sole factors determining migratory movements. Potters started to travel northward after their products were already diffused and highly appreciated in the area. In fact, middlemen seem to have played (and still play) a crucial role in the choice of migratory destinations. At the time of my enquiries, migrations

were occurring at various scales, depending on the age and social status of the potters. Intra- and inter-communal movements seemed partly related to the learning process and the typically male notion of *gucha* ('moving out'): moving out of the father's physical presence when adolescent, moving out of the village when entering adulthood, moving out of other people's protection or subordination after marriage. More distant seasonal migrations were made by adult potters struggling to support their family. Destinations could then vary or remain the same from one season to the next, depending on local economic opportunities. Finally, older potters did not engage in seasonal migrations any more, having chosen to continue working in their home community (sometimes hiring younger potters to increase their production output) or to relocate permanently with their family in a former seasonal destination.

We thus see that many of the situations described by Ramón combine at various scales in Niger, contributing to the dissemination of a pottery tradition. More importantly, we see that the 'entrepreneurial', 'opportunistic' mobility of craft specialists does not develop randomly through space and time, but is intimately connected to the political, economic and social circumstances that shape people's daily life.

Community

The local confrontation of different communities and the existence – or non-existence – of technical transfer between them is a recurring theme throughout the volume. When distinct technical traditions co-occur on certain sites and can be separated into 'local' and 'foreign', the obvious explanation is that both networks of producers worked independently from each other. This seems to be the case at Tell Kazel, Syria, where a small proportion of handmade pottery appears in a context dominated by local wheel-thrown imitations of Aegean vessels (Boileau), in central Macedonia and central Mediterranean, where a locally produced wheel-thrown Mycenaean pottery coexists with a long-lived tradition of handmade pottery (Kiriati and Andreou), or in south Aegean, where different types of smelting furnaces were used in the same areas (Georgakopoulou). In other instances, there appears to be a blending of distinctly foreign and local traditions. In South Aegean wall paintings, for example, the techniques used were Cretan while the stylistic elements and the repertoire were Aegean. Given the familiarity of painters with Aegean aesthetical and ideological codes and the fact that the innovations were widely distributed, Nikolakopoulou

and Knappett postulate that wall paintings were made by local craftspeople who had undergone a period of apprenticeship with Cretan specialists. But “[h]ow ‘exposed’ were island communities and local craftsmen to technological advances implemented in Crete?” they ask. A good question and a good choice of word, since ‘exposition’ not only conditions the possibility of acquiring skill, but, more essentially, the possibility of *knowing* that things are/can be done differently. When archaeological data point towards the absence of relationships between different communities of practice, one can envision several scenarios: mere indifference, deliberate rejection of traditions associated with despised people, impossibility of entering learning networks (because of status or gender, for example), ... or mere ignorance. Can we reasonably rule out the last possibility in the archaeological examples evoked above? How sure can we be that ‘foreign’ and ‘local’ artisans actually met each other at Tell Kazel or on Macedonian and central Mediterranean sites?

Although the problem of the spatial and chronological accuracy of archaeological analyses is hardly new, it cannot be ignored when exploring questions of social interactions. For example, provenance studies greatly help in distinguishing ‘local’ from ‘imported’ artefacts. Yet in regard to local productions, one cannot ascertain that the bearers of different technical traditions shared a similar territory of exploitation – and had opportunities to interact – unless (1) specific sources of raw materials are identified and (2) analyses demonstrate that both groups exploited them simultaneously. In the pottery examples evoked above, available information on paste recipes show in fact that it was probably not the case. Did both groups share the same marketplaces, then? Or did they work in distinct, yet close, workshops? None of the data discussed provides answers. Similarly, interpretations pertaining to the presence or absence of technical transfer unavoidably conflate contrasting timescales. When envisioning the possible exposure of local artisans to the activities of seasonal migrants, or the actual learning of specific techniques, time durations are mostly in the order of several months to several years. Archaeological time periods, by contrast, are often in the order of centuries. The latter thus conflate a constellation of events and life trajectories, with the result that only broad, time-enduring tendencies can be detected. Finally, there is the ‘compressive’ nature of archaeological assemblages, within which objects made at different moments in time are liable to be found in association. Let us think, for example, of the numerous West African compounds where modern cooking pots and serving bowls are found alongside water jars made one or two generation(s) earlier (e.g. [Mayor 1994](#)).

If I dare venture on an archaeological ground that obviously falls outside my field of expertise, it is because of the crucial importance of *relations* in the development and evolution of communities of practice. As amply discussed by Lave (1996; 2011), practice rests upon a set of relations: relation between persons acting, and relations between the social and material worlds. Such relations do not merely delineate a socio-historical framework within which artisans operate. They actually partially determine how artisans shape and give meaning to their daily engagement in the craft: how they interact with each other, share knowledge, use tools and materials, cope with changing situations or seize new opportunities. Determining whether members of different communities of practice could or could not interact is thus a prerequisite to any discussion devoted to technical transfer. A second prerequisite is to document the contexts within which interactions – if any – took place. In that regard, a possible way to overcome problems of archaeological visibility and accuracy is to focus on what Wenger (1998) calls the ‘geography of practice’, a configuration of ‘localities’ that not only emerge from physical proximity or frequency of interaction but, more importantly, from learning.

The members of an incipient community of practice may belong to very different localities of practice to start with, but – after sustaining enough mutual engagement – they will end up creating a locality of their own, even if their backgrounds have little in common.

(Wenger 1998, 130)

Regarding the craft practices discussed in the volume, ‘localities’ notably correspond to sites where artisans are brought together in the conduct of specific operations. Such sites thus become the loci of communal practice and knowledge exchange. Bevan and Bloxam provide a good illustration in their study of Egyptian stonemasons. They show that stone-working collectives developed in quarries and road construction sites and that these ‘contexts’ provided “possibilities for horizontal transmission of technological know-how between local and non-local specialist groups”. In some quarries, technical traditions were maintained through generations and only slightly modified or reoriented after the arrival of foreign specialists, which supposes the existence of a large and time-enduring local community of stone-workers. As shared sites, the ore mines and smelting areas discussed by Georgakopoulou also provided good opportunities for knowledge exchange. There, however, no technical transfer took place, either because the seasonal sojourns of specialists were too short to favour such transfers or because the diverse communities operating on the sites avoided each other.

Considering practice from a geographical point of view also helps in conceptualising the various scales at which craft communities are liable to develop, but also the many circumstances in which they do so. For pottery making, iron smelting, or stone-working do not generate communities of practice spontaneously: as connectivity, they only provide *opportunities* for the development of multiple forms of social relations. In a detailed, long-term study of central Nigerian potting villages, Corniquet (2011; 2014) has notably identified three spatial contexts promoting interactions and knowledge exchange between potters: weekly markets, clay extraction sites and firing sites. The first brings together potters from villages situated in a 15–30 km radius. Spending the day together in a specific part of the market, they compare productions, become aware of customers' tastes and fads, and exchange technical information. Networks of villages sharing a clay source have a 5–10 km radius. Here, casual or regular encounters between potters allow exchanges on the selection of raw materials and clay processing recipes, but also other aspects of the craft. Looking at the spatial distribution of tools, techniques and pottery styles in the area, it is clear that both contexts have a strong impact on the circulation of knowledge. They also give rise to supra-communal practice frameworks, within which potters of different origin develop a sense of mutual engagement and belonging. The last context – firing sites – occurs at an intra-communal scale, when several potters of the same villages regroup for firing their pieces. Based initially on kinship, friendship and neighbourhood ties, these regular firing parties generate micro potting communities that are characterised both by a strong bonding of members and the development of specific technical practices not necessarily restricted to the firing process. As concluded by Corniquet (2014, 276), it is by paying attention to the various spatial contexts where practice and interactions take place that one can hope to approach the history of technical traditions.

Utility

'Diffusion' or 'acculturation' should not be approached as distinct historical processes, but as situations among others in the ongoing transformation of societies. The negotiation of meaning that takes place when an innovation is adopted is indeed similar to that taking place when the function of a local practice or item is transformed. Both are intimately related to broader transformations occurring in the context to which they belong. A key concept here is *utility*: how *useful* an object or a practice may be in

given circumstances. This usefulness is unrelated to the supposed intrinsic advantages of an innovation – as classically highlighted in the theory of the diffusion of innovations (Rogers 1995). It pertains rather to ‘social utility’, an ongoing and situated process of meaning construction that may be witnessed in the historical evolution of assemblages and their geographical variants. In this section, I will discuss some relevant components of this process, drawing partly on reflexions developed by Wenger (1998) and the conclusions of a multidisciplinary project on cultural dynamics with which I was associated (Zeebroek et al. 2008).

As illustrated in most of the volume’s contributions, the analysis of diffused objects, techniques or ideas cannot be divorced from that of the social circumstances surrounding their use. Cultural items are indeed fully integrated in geographically, historically and socially situated practices. Analysing their circulation and evolution therefore forces us to consider ‘trajectories’ of practices that constantly associate people, things, materials and representations. This is where Wenger’s reflexions on ‘reification’ and ‘participation’ may be helpful. The concept of ‘reifications’ refers “to the process of giving form to our experience by producing objects that congeal that experience into ‘thingness.’” (Wenger 1998, 58). Such objects are products similar to those analysed throughout the book (e.g. pots, glass objects, frescos, architectural elements), but also words, formulas or written documents. Be they tangible or intangible, they always embody the conditions under which they were produced. In artefacts, such conditions correspond to ‘technological styles’, a notion encompassing materials and technical actions as well as representations and a set of economic, political and social relations (e.g. Dobres 2000). Reifications also reflect the conditions of their use. More importantly, they constitute points of focus around which subsequent negotiations of meaning may take place.

Due to changing social circumstances, reifications need indeed to be reassessed and reappropriated to remain meaningful. This process has been especially documented in material culture studies focusing either on the local appropriation of foreign objects (e.g. Thomas 1991) or the historical trajectory of individual objects or classes of objects (e.g. Kopytoff 1986; Bonnot 2002). The interest of Wenger’s propositions is that they allow broadening the scope of analysis in including technical actions or any other cultural practices. As illustrated in the aforementioned studies, reification may be subjected to divergent interpretations in varying contexts. Wenger (1998, 63–71) contends that such variation depends on the way meaning is balanced between reification and participation: the fate of objects, techniques or ideas would fluctuate according to the social interactions in

which they are embedded (see also discussion in Kiriati and Andreou). For instance, one should carefully consider “the limited distance that reification, if unaccompanied by people, can in fact travel through time and space without the risk of divergent interpretations” (Wenger 1998, 111). Among the many examples of unaccompanied reifications discussed in the book, imported ‘drinking’ and ‘serving’ vessels notably caught my attention, since their functional and symbolic status are sometimes interpreted as having remained unchanged in contexts of reception. They would thus testify to the introduction of new consumption practices (e.g. Nikolakopoulou and Knappett; Kiriati and Andreou). Granted, the physical characteristics of imported products may have been sufficiently familiar to local adopters to require only a limited amount of reinvention (unlike the famous example of the coke bottle in the 1986 movie *The gods must be crazy*). To put it another way, they may have ‘afforded’ similar uses. But as objects have a bundle of qualities that are only partially exploited in meaning constructions (e.g. Keane 2005), functional and classificatory distortions are bound to happen when individuals have a limited knowledge of the original contexts of production and consumption – as illustrated by the current use of Chinese enamelware in a large portion of West Africa (Gosselain et al. 2008; Zeebroek et al. 2008). Thus, the possibility that the function of imported vessels has remained unchanged in local contexts must be demonstrated and explained, for it points towards specific historical processes: either a concomitant movement of things and people (as suggested by Boileau) or the existence of strong and ongoing relations between distant communities (as suggested by Nikolakopoulou and Knappett). Other categories of objects may prove less ambiguous in regard to their historical trajectory. In the example of the flange-hilted type swords discussed by Kristiansen, the fact that these objects are “part of a system of warfare and skills that demand long-term training” would mean that their shared use in Scandinavia, central Europe and the Aegean resulted from the movements of travelling warriors.

This brings us back to techniques and the crucial importance of vectors through which knowledge circulates. Most of the technical transfers evoked throughout the book imply a good balance between reification and participation, and hence sustained interactions between people. But direct interactions are not a prerequisite for transfer. For example, south Aegean potters did not only imitate the shapes and motifs of imported Minoan vessels, but also salient Cretan fabrics and surface treatments (Nikolakopoulou and Knappett). Here, the balance between reification and participation was clearly tipped towards the former. Conversely, the

adoption of wheel-throwing would have implied a long period of learning only made possible through participation in a community of practice. Depending on the technical aspects and the level of expertise of the artisans, there are thus gradients in the level of participation required for ensuring the transfer of technical knowledge from one context to the next. This is hardly new and most contributors obviously integrated this idea in their reasoning. My point, here, is that the way in which techniques mobilise reifications and participations, and the balance they establish between them, influence their meaning as well as their trajectory. In certain occasions, their very characteristics may not only determine the condition under which they are reproduced, but also the construction of their social utility. In the case of pottery shaping techniques, for example, ethnographical observations in West Africa show that learning generally implies a period of close interaction between kin-related masters and apprentices. Potters consequently develop conservative views about shaping techniques, as the latter materialises kinship and inter-generational ties. The notion of 'inheritance' that constantly crops up in interviews underlines the initial asymmetry of the learning relationship and situates shaping among the broader category of things transmitted by parents and ancestors in general. Here, the meaning attached to shaping techniques – their 'social utility' – allows potters to shape both their identity and pottery vessels through craft practice. More importantly for archaeologists, social utility is seen to weigh heavily on the historical and geographical trajectories of shaping techniques.

To conclude, I want to stress the importance of this volume edited by Kiriatzi and Knappett. In considering both human mobility and technical transfer, its contributors do not only improve the archaeological understanding of specific areas and time-periods, but, more crucially, work towards a better integration of anthropological tools and concepts in archaeology. Doing so, they 'open' a world constituted not only of materials and artefacts but also of persons, actions and social relations. A history made of flesh, in other words. What better could be achieved by scholars interested in past people?

Bibliography

- Abdel-Rahman, A.-F. M. (2002). "Mesozoic volcanism in the Middle East: geochemical, isotropic and petrogenetic evolution of extension-related alkali basalts from central Lebanon". *Geological Magazine* 139, pp. 621–40.
- Abdel-Rahman, A.-F. M. and F. H. Nader (2002). "Characterization of the Lebanese Jurassic-Cretaceous carbonate stratigraphic sequence: a geochemical approach". *Geological Journal* 37, pp. 69–91.
- Abdel-Rahman, A.-F. M. and P. E. Nassar (2004). "Cenozoic volcanism in the Middle East: petrogenesis of alkali basalts from northern Lebanon". *Geological Magazine* 141, pp. 545–63.
- Abell, N. (2014). *Reconsidering a Cultural Crossroads: A Diachronic Analysis of Ceramic Production, Consumption, and Exchange Patterns at Bronze Age Ayia Irini, Kea, Greece*. PhD Thesis. University of Cincinnati.
- Abulafia, D. (2011). *The Great Sea: A Human History of the Mediterranean*. Oxford: Oxford University Press.
- Adey, P. (2010). *Mobility*. London: Routledge.
- Alberti, M. E. and S. Sabatini, eds. (2012). *Exchange Networks and Local Transformations. Interaction and Local Change in Europe and the Mediterranean from the Bronze Age to the Iron Age*. Oxford and Oakville, CT: Oxbow Books.
- Alcock, S. E. (2005). "Alphabet soup in the Mediterranean basin: the emergence of the Mediterranean serial". In: *Rethinking the Mediterranean*. Ed. W. V. Harris. Oxford: Oxford University Press, pp. 314–36.
- Alexander, J. (2007). "The introduction and use of masons' marks in Romanesque buildings in England". *Medieval Archaeology* 51, pp. 63–81.
- Amin, A. and P. Cohendet (2004). *Architectures of Knowledge: Firms, Capabilities and Communities*. Oxford: Oxford University Press.
- Andrassy, P. (2009). "Die Teammarken der Bauleute des Ägyptischen Alten und Mittleren Reiches". In: *Pictograms or Pseudo Script? Non-Textual Identity Marks in Practical Use in Ancient Egypt and Elsewhere. Proceedings of a Conference in Leiden, 19–20 December 2006*. Ed. B. J. J. Haring and O. E. Kaper. Leuven: Peeters, pp. 5–48.
- Andreou, S. (2003). "Mycenean pottery and Macedonian societies during the Late Bronze Age". In: *The Periphery of the Mycenaean World. Proceedings of the 2nd International Interdisciplinary Colloquium, Lamia, 26–30 September 1999*. Ed. N. Kyprissi-Apostolika and M. Papakonstantinou. Athens: Ministry of Culture. ΙΔ' Ephorate of Prehistoric and Classical Antiquities, pp. 191–210.

- (2009). "Stratified wheelmade pottery deposits and absolute chronology of the LBA to the EIA transition at Thessaloniki Toumba". In: *LHIIIC Chronology and Synchronisms III. LHIIIC Late and the Transition to the Early Iron Age. International Workshop held at the Austrian Academy of Sciences at Vienna, February 23rd and 24th 2007*. Ed. S. Deger-Jalkotzy and A. E. Bächle. Wien: Verlag der Österreichischen Akademie der Wissenschaften, pp. 15–40.
- (2010). "Northern Aegean". In: *The Oxford Handbook of The Bronze Age Aegean (ca. 3000–1000 BC)*. Ed. E. H. Cline. Oxford: Oxford University Press, pp. 643–59.
- Andreou, S. and K. Kotsakis (1987). "Diastaseis tou chorou stin kentriki Makedonia: apotuposi tis endokoinotikis kai diakoinotikis choroorganosis". In: *AMITOS. Timitikos Tomos gia ton Kathigiti M. Androniko*. Thessaloniki: Aristotle University of Thessaloniki, pp. 55–88.
- Andreou, S. and K. Psaraki (2007). "Tradition and innovation in the Bronze Age pottery of the Thessaloniki Toumba". In: *The Struma/Strymon River Valley in Prehistory. Proceedings of the International Symposium Strymon Praehistoricus, Kjustendil-Blagoevgrad (Bulgaria) and Serres-Amphipolis (Greece), 27.09-01.10.2004*. Ed. M. Stefanovich, H. Todorova, and G. Ivanov. In the Steps of James Harvey Gaul. Volume 2. Sofia: Gerda Henkel Stiftung, pp. 397–420.
- Andreou, S., M. Fotiadis and K. Kotsakis (2001). "Review of Aegean Prehistory V: The Neolithic and Bronze Age of Northern Greece". In: *Aegean Prehistory. A Review*. Ed. T. Cullen. American Journal of Archaeology. Supplement 1. Boston: Archaeological Institute of America, pp. 259–327.
- Andreou, S., S. Dimitriadis, V. Kilikoglou, E. Kiriati, K. Kotsakis and A. Tsolakidou (2003). "Measuring demand and supply of Mycenaean and Protogeometric style pottery in Late Bronze Age Macedonia with special reference to Thessaloniki Toumba". In: *METRON: Measuring the Aegean Bronze Age. Proceedings of the 9th International Aegean Conference, New Haven, Yale University, 18–21 April 2002*. Ed. K. P. Foster and R. Laffineur. Aegaeum 24. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, p. 495.
- Andreou, S., C. Heron, G. Jones, V. Kiriati, K. Psaraki, M. Roumbou and S. M. Valamoti (2013). "Smelly barbarians or perfumed natives? An investigation of oil and ointment in use in Late Bronze Age northern Greece". In: *Diet, Economy and Society in the Ancient Greek World: Towards a Better Integration of Archaeology and Science: Proceedings of the International Conference held at the Netherlands Institute at Athens on 22–24 March 2010*. Ed. S. Voutsaki and S.-M. Valamoti. *Pharos* Supplement 1. Leuven: Peeters, pp. 173–85.
- Aner, E., K. Kersten and K.-H. Willroth (2011). *Der Kreis Segeberg*. Die Funde der älteren Bronzezeit des Nordischen Kreises in Dänemark, Schleswig-Holstein und Niedersachsen 20. Neumünster: Wachholz Verlag.

- Angelini, I., G. Artioli, P. Bellintani, V. Diella, M. Gemmi, A. Polla and A. Rossi (2004). "Chemical analyses of Bronze Age glasses from Frattesina di Rovigo, northern Italy". *Journal of Archaeological Science* 31.8, pp. 1175–84.
- Arnold, D. (1991). *Building in Egypt: Pharaonic Stone Masonry*. Oxford: Oxford University Press.
- Arnold, D. and D. Arnold (1979). *Der Temple Qasr el-Sagha*. Archäologische Veröffentlichungen 27. Mainz: German Archaeological Institute.
- Arnold, F. (1990). *The South Cemeteries of Lisht Volume II: The Control Notes and Team Marks*. New York: Metropolitan Museum of Art.
- Aslaksen, O. C. (2013). *Global and Local in Late Bronze Age Central Macedonia: Economy, Mobility and Identity*. GOTARCB61. Göteborg: Göteborgs Universitet. Institutionen för Historiska studier.
- Aubet, M. E. (2001). *The Phoenicians and the West: Politics, Colonies and Trade*. 2nd edn. Cambridge and New York: Cambridge University Press.
- (2013). *Commerce and Colonization in the Ancient Near East*. Cambridge: Cambridge University Press.
- Babić, S. and M. Tomović (1996). *Milutin Garasanin: Razgovori o Arheologiji*. Beograd: "3T" d.o.o.
- Bachmann, M. (2009). "Hellenistische Steinmetzmarken im westlichen Kleinasien". In: *Non-Textual Marking Systems, Writing and Pseudo Script from Prehistory to Modern Times*. Ed. P. Andrassy, J. Budka, and F. Kammerzell. Göttingen: Seminar für Ägyptologie und Koptologie, pp. 215–31.
- Badre, L. (2003). "Handmade burnished ware and contemporary imported pottery from Tell Kazel". In: *Ploes... Sea Routes...: Interconnections in the Mediterranean, 16th–6th c. BC. Proceedings of the International Symposium held at Rethymnon, Crete, September 29th–October 2nd 2002*. Ed. N. C. Stampolidis and V. Karageorghis. Athens: A. G. Leventis Foundation/University of Crete, pp. 83–96.
- (2006). "Tell Kazel-Simyra: a contribution to a relative chronological history in the Eastern Mediterranean during the Late Bronze Age". *Bulletin of the American School of Oriental Research* 343, pp. 65–95.
- Badre, L. and E. Gubel (1999–2000). "Tell Kazel Syria: excavations of the AUB Museum, 1993–1998, third preliminary report". *Berytus* 44, pp. 123–203.
- Badre, L., E. Gubel, M. Al-Maqdissi, and H. Sader (1990). "Tell Kazel, Syria: AUB Museum Excavations 1985–1987. Preliminary report". *Berytus* 38, pp. 10–124.
- Badre, L., E. Gubel, E. Capet, and N. Panayot (1994). "Tell Kazel (Syrie): Rapport préliminaire sur les 4è–8è campagnes de fouilles (1988–1992)". *Syria* 71, pp. 259–346.
- Badre, L., M.-C. Boileau, R. Jung, and H. Mommsen (2005). "The provenance of Aegean- and Syrian-type pottery found at Tell Kazel (Syria)". *Ägypten und Levante* 15, pp. 15–47.
- Bähr, V., R. Krause, and R. Gebhard (2012). "Neue Forschungen zu den Befestigungen auf dem Bernstorfer Berg bei Kranzberg im Landkreis Freising (Oberbayern)". *Bayerische Vorgeschichtsblätter* 77, pp. 5–41.

- Bajnóczi, B., G. Schöll-Barna, N. Kalicz, Zs. Siklósi, G. Hurmuziadis, F. Ifantidis, Ni. Kyparissi-Apostolika, M. Pappa, R. Veropoulidou, and Ch. Ziota (2013). "Tracing the source of Late Neolithic *Spondylus* shell ornaments by stable isotope geochemistry and cathodoluminescence microscopy". *Journal of Archaeological Science* 40, pp. 874–82.
- Balfet, H. (1991). "Des chaînes opératoires, pour quoi faire?". In: *Observer l'action technique: Des chaînes opératoires, pour quoi faire?* Ed. H. Balfet. Paris: Éditions du CNRS, pp. 11–20.
- Barber, E. J. W. (1991). *Prehistoric Textiles: The Development of Cloth in the Neolithic and Bronze Ages with Special Reference to the Aegean*. Princeton and Oxford: Princeton University Press.
- Barjamovic, G. (2011). *A Historical Geography of Anatolia in the Old Assyrian Colony Period*. Carsten Niebuhr Institute Publications 38. København: Museum Tusculanum Press.
- Barnard, H. and W. Wendrich (2008). *The Archaeology of Mobility: Old World and New World Nomadism*. Los Angeles: Cotsen Institute of Archaeology Press.
- Bartelheim, M. and H. Stäuble, eds. (2009). *The Economic Foundations of the European Bronze Age*. Forschungen zur Archäometrie und Altertumswissenschaft 4. Rahden/Westfalen: Verlag Marie Leidorf.
- Barton, R. N. E, C. B. Stringer, and J. C. Finlayson, eds. (2012). *Neanderthals in Context: A Report of the 1995–1998 Excavations at Gorham's and Vanguard Caves, Gibraltar*. Monograph 75. Oxford: School of Archaeology.
- Bass, G. F. (1967). *Cape Gelidonya: A Bronze Age Shipwreck*. Transactions of the American Philosophical Society 57.8. Philadelphia: American Philosophical Society.
- (1990). "A Bronze-age writing-diptych from the sea off Lycia". *Kadmos* 29, pp. 168–9.
- Bassiakos, Y. and M. Catapotis (2006). "Reconstruction of the copper smelting process based on the analysis of ore and slag samples". In: *The Chrysokamino Metallurgy Workshop and its Territory*. Ed. P. P. Betancourt. Hesperia. Supplement 36. Princeton: American School of Classical Studies at Athens, pp. 329–53.
- Bassiakos, Y. and C. Doumas (1998). "The island of Keros and its enigmatic role in the Aegean E.B.A.: a geoarchaeological approach". In *Argyritis Gi: Charisterion ston Konstantino I. Conophago*. Athens: NTUA Press, pp. 55–64.
- Bassiakos, Y. and O. Philaniotou (2007). "Early copper production on Kythnos: archaeological evidence and analytical approaches to the reconstruction of the metallurgical process". In: *Metallurgy in the Early Bronze Age Aegean*. Ed. P. M. Day and R. C. P. Doonan. Sheffield Studies in Aegean Archaeology 7. Oxford: Oxbow Books, pp. 19–56.
- Bassiakos, Y. and Th. Tselios (2012). "On the cessation of local copper production in the Aegean in the 2nd millennium BC". In: *Eastern Mediterranean Metallurgy and Metalwork in the Second Millennium BC: A Conference in Honour of*

- James D. Muhly, *Nicosia, 10th–11th October 2009*. Ed. V. Kassianidou and G. Papasavvas. Oxford: Oxbow Books, pp. 151–61.
- Beaudry, M. C. and T. G. Parno (2013). “Introduction: mobilities in contemporary and historical archaeology”. In: *Archaeologies of Mobility and Movement*. Ed. M. C. Beaudry and T. G. Parno. New York: Springer, pp. 1–14.
- Beaujard, P. (2012). *Les Mondes de L’Océan Indien*, volume 1. *De la Formation de l’Etat au Premier Système-Monde Afro-eurasien (4e millenaire av. J.-C. siècle ap. J.-C.)*. Paris: Armand Colin.
- Beck, H. (1934). “Glass before 1500 BC”. *Ancient Egypt* (June), pp. 7–21.
- Begg, I. (2004a). “An interpretation of mason’s marks at Knossos”. In: *Knossos: Palace, City, State. Proceedings of the Conference in Herakleion Organised by the British School at Athens and the 23rd Ephoreia of Prehistoric and Classical Antiquities of Herakleion, in November 2000, for the Centenary of Sir Arthur Evans’s Excavations at Knossos*. Ed. G. Cadogan, E. Hatzaki, and A. Vasilakis. British School at Athens Studies 12. London: British School at Athens, pp. 219–23.
- (2004b). “An archaeology of palatial mason’s marks on Crete”. In: *Charis Essays in Honor of Sara A. Immerwahr*. Ed. A. P. Chapin. Hesperia. Supplement 33. Princeton: American School of Classical Studies at Athens, pp. 1–25.
- Bell, C. (2005). “Wheels within wheels? A view of Mycenaean trade from the Levantine emporia”. In: *EMPORIA: Aegeans in the Central and Eastern Mediterranean: Proceedings of the 10th International Aegean Conference/10e Rencontre égéenne internationale, Athens, Italian School of Archaeology, 14–18 April 2004*. Ed. R. Laffineur and E. Greco. *Aegaeum* 25. Liège and Austin, TX: Université de Liège, Histoire de l’art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 363–9.
- (2012). “The merchants of Ugarit: oligarchs of the Late Bronze Age trade in metals?”. In: *Eastern Mediterranean Metallurgy and Metalwork in the Second Millennium BC: A Conference in Honour of James D. Muhly, Nicosia, 10th–11th October 2009*. Ed. V. Kassianidou and G. Papasavvas. Oxford: Oxbow Books, pp. 180–7.
- Bellintani, P. (1998). “Canàr di San Pietro Polesine. Breve sintesi sugli studi archeologici”. In: *San Pietro Polesine. Ricerche Archeo-ambientali sul Sito Palafitticolo*. Ed. C. Balista and P. Bellintani. Padusa Quaderni 2. Rovigo: Centro Polesano di Studi Storici Archeologici ed Etnografici, pp. 15–21.
- Bellintani, P. and G. Residori (2003). “Quali e quante conterie; perle ed altri materiali vetrosi dell’Italia settentrionale nel quadro dell’età del Bronzo Europea”. In: *Atti della XXXV Riunione Scientifica; le Comunità della Preistoria Italiana; Studi e Ricerche sul Neolitico e le Età dei Metalli. Castello di Lipari, Chiesa di S. Caterina, 2–7 Giugno 2000: In memoria di Luigi Bernabò Brea*. Ed. D. Cocchi Genick. Florence: Istituto Italiano di Preistoria e Protostoria, pp. 483–98.
- Bennet, J. and J. L. Davis (1999). “Making Mycenaean: warfare, territorial expansion, and representations of the other in the Pylian Kingdom”. In: *POLEMOS: Le*

- Contexte Guerrier en Égée à l'Âge du Bronze. Actes de la 7e Rencontre égéenne internationale, Université de Liège, 14–17 avril 1998.* Ed. R. Laffineur. *Aegaeum* 19. Liège and Austin, TX: Université de Liège Histoire de l'art et archéologie de la Grèce antique and University of Texas, Program in Aegean Scripts and Prehistory, pp. 105–20.
- Bentley, R. A. (2006). "Strontium isotopes from the earth to the archaeological skeleton: a review". *Journal of Archaeological Method and Theory* 13.3, pp. 135–87.
- Bentley, R. A. and M. J. O'Brien (2011). "The selectivity of social learning and the tempo of cultural evolution". *Journal of Evolutionary Psychology* 9, pp. 125–41.
- Bernabò Brea, M. and A. Cardarelli (1997). "La terramare nel tempo". In: *Le Terramare: La più antica civiltà padana. Modena, Foro Boario, 15 marzo–1 giugno 1997. Catalogo della Mostra.* Ed. M. Bernabò Brea, A. Cardarelli and M. Cremaschi. Modena: Electa, pp. 295–378.
- Bernabò Brea, M., A. Cardarelli and M. Cremaschi, eds. (1997). *Le Terramare: La più antica civiltà padana. Modena, Foro Boario, 15 marzo–1 giugno 1997. Catalogo della Mostra.* Modena: Electa.
- Betancourt, P. P., ed. (2006a). *The Chrysokamino Metallurgy Workshop and its Territory.* Hesperia Supplement 36. Princeton: American School of Classical Studies at Athens.
- Betancourt, P. P. (2006b). "Discussion of the workshop and reconstruction of the smelting practices". In: *The Chrysokamino Metallurgy Workshop and its Territory.* Ed. P. P. Betancourt. Hesperia Supplement 36. Princeton: American School of Classical Studies at Athens, pp. 179–89.
- (2006c). "Survey conclusions". In: *The Chrysokamino Metallurgy Workshop and its Territory.* Ed. P. P. Betancourt. Hesperia. Supplement 36. Princeton: American School of Classical Studies at Athens, pp. 257–78.
- Bettelli, M. (2002). *Italia Meridionale e Mondo Miceneo: Ricerche su dinamiche di acculturazione e aspetti archeologici, con particolare riferimento ai versanti adriatico e ionico della penisola italiana.* Grandi contesti e problemi della Protostoria italiana 5. Florence: All'Insegna del Giglio.
- Bettelli, M., I. Damiani and L. Vagnetti (2006). "Prime osservazioni sulla circolazione e la lavorazione dell'avorio in Italia durante l'età del bronzo". In: *Atti della XXXIX Riunione Scientifica: Materie prime e scambi nella preistoria italiana. Firenze, 25–27 novembre 2004, volume 3.* Ed. D. Cocchi Genick. Florence: Istituto Italiano di Preistoria e Protostoria, pp. 905–16.
- Bettencourt, L. M., A. Cintron-Arias, D. I. Kaiser and C. C. Chavez (2006). "The power of a good idea: quantitative modeling of the spread of ideas from epidemiological models". *Physica A* 364, pp. 513–6.
- Bevan, A. (2007). *Stone Vessels and Values in Bronze Age Mediterranean.* Cambridge: Cambridge University Press.
- (2010a). "Making and marking relationships: Bronze Age brandings and Mediterranean commodities". In: *Cultures of Commodity Branding.* Ed. A. Bevan and D. Wengrow. Walnut Creek, CA: Left Coast Press, pp. 35–85.

- (2010b). "Political geography and palatial Crete". *Journal of Mediterranean Archaeology* 23.1, pp. 27–54.
- Bevan, A. H. (2014). "Mediterranean containerization". *Current Anthropology* 55, pp. 387–418.
- Bevan, A. and J. Conolly (2013). *Mediterranean Islands, Fragile Communities and Persistent Landscapes: Antikythera in Long-Term Perspective*. Cambridge: Cambridge University Press.
- Beydoun, Z. R. (1977). "The Levantine countries: the geology of Syria and Lebanon (maritime regions)". In: *The Ocean Basins and Margins*, vol. 4A. *The Eastern Mediterranean*. Ed. A. E. M. Nairn, W. H. Kanes, and F. G. Stehli. New York: Plenum Press, pp. 319–50.
- Bietti Sestieri, A. M. (2010). *L'Italia nell' Età del Bronzo e del Ferro: Dalle Palafitte a Romolo*. Rome: Carocci.
- Binford, S. R. and L. Binford (1968). *New Perspectives in Archaeology*. Chicago: Aldine Press.
- Birtacha, K. and M. Zacharioudakis (2000). "Stereotypes in Thera wall paintings: modules and patterns in the procedure of painting". In: *The Wall Paintings of Thera: Proceedings of the First International Symposium, P.M. Nomikos Conference Centre, Thera, 30 August–4 September 1997*, vol. 1. Ed. S. Sherratt. Athens: Thera Foundation/Petros M. Nomikos and The Thera Foundation, pp. 159–72.
- Björk, C. (1995). *Early Pottery in Greece: A Technological and Functional analysis of the Evidence from Neolithic Achilleion Thessaly*. Studies in Mediterranean Archaeology 115. Jonsered, Sweden: Paul Åströms Förlag.
- Blake, E. (2008). "The Mycenaeans in Italy: a minimalist position". *Papers of the British School at Rome* 76, pp. 1–34.
- Blake, E., and A. B. Knapp, eds. (2005). *The Archaeology of Mediterranean Prehistory*. Oxford: Blackwell Publishing.
- Blakolmer, F. (2000). "The functions of wall painting and other forms of architectural decoration in the Aegean Bronze Age". In: *The Wall Paintings of Thera: Proceedings of the First International Symposium, Petros M. Nomikos Conference Centre, Thera, Hellas, 30 August–4 September 1997*, vol. 1. Ed. S. Sherratt. Athens: Thera Foundation/Petros M. Nomikos and The Thera Foundation, pp. 393–412.
- Blanton, R., G. Feinman, S. Kowalewski and P. Peregrine (1996). "A dual-processual theory for the evolution of the Mesoamerican civilization". *Current Anthropology* 37.1, pp. 1–14.
- Blondel, J., J. Aronson, J. -Y. Bodiou and G. Boeuf (2010). *The Mediterranean Region: Biological Diversity in Time and Space*. 2nd edn. Oxford and New York: Oxford University Press.
- Bloxam, E. G. (2006). "Miners and mistresses: Middle Kingdom mining on the margins". *Journal of Social Archaeology* 6.2, pp. 277–303.
- (2009). "New directions in identifying the significance of ancient quarry landscapes: four concepts of landscape". In: *QuarryScapes: Ancient Stone Quarry*

- Landscapes in the Eastern Mediterranean*. Ed. N. Abu-Jaber, E. G. Bloxam, P. Degryse and T. Heldal. Geological Survey of Norway Special Publication 12. Trondheim: NGU Geological Survey of Norway, pp. 163–81.
- (2011a). “Ancient quarries in mind: pathways to a more accessible significance”. *World Archaeology* 43.2, pp. 149–66.
- (2011b). “Visualising the invisible: re-discovering the ancient grinding stone quarries of the Aswan West Bank, Egypt”. In: *Bread for the People: The Archaeology of Mills and Milling. Proceedings of a Colloquium held in the British School at Rome, 4th–7th November 2009*. Ed. D. Peacock and D. Williams. Oxford: Archaeopress, pp. 43–53.
- (2011c). “Forgotten people and places: new perspectives on the social context of ancient quarrying in Egypt”. *General Anthropology* 18.1, pp. 1–6.
- (2015). “A place full of whispers: socializing the quarry landscape of the Wadi Hammamat”. *Cambridge Archaeological Journal* 25, pp. 789–814.
- Bloxam, E. and T. Heldal (2007). “The industrial landscape of the Northern Faiyum Desert as a world heritage site: modelling ‘outstanding universal value’ of 3rd millennium BC stone quarrying in Egypt”. *World Archaeology* 39.3, pp. 305–23.
- (2008). *Identifying Heritage Values and Character-Defining Elements of Ancient Quarry Landscapes in the Eastern Mediterranean: An Integrated Analysis*. Work Package 8, Deliverable No. 10. INCO-CT-2005-015416-Project QuarryScapes (www.quarryscapes.no/text/publications/QS_del10_wp8_reportH.pdf).
- Bloxam, E. G. and P. Storemyr (2002). “Old Kingdom basalt quarrying activities at Widan el-Faras, Northern Faiyum Desert”. *Journal of Egyptian Archaeology* 88, pp. 23–36.
- Bloxam, E., T. Heldal, and P. Storemyr, eds. (2007). *Characterisation of Complex Quarry Landscapes: An Example from the West Bank Quarries, Aswan*. Work Package 4, Deliverable No. 4. INCO-CT-2005-015416-Project QuarryScapes (http://www.quarryscapes.no/text/publications/QS_del4_Report_LR.pdf).
- Bloxam, E. G., P. Storemyr and T. Heldal (2009). “Hard stone quarrying in the Egyptian Old Kingdom (3rd millennium BC): re-thinking the social organisation”. In: *ASMOSIA VII: The Study of Marble and Other Stones in Antiquity. Proceedings of the 7th International Conference of the Association for the Study of Marble and Other Stones in Antiquity*. Ed. Y. Maniatis. Bulletin de Correspondance Hellénique Supplement 51. Athens: École française d’Athènes, pp. 187–201.
- Bloxam, E., J. Harrell, A. Kelany, N. Moloney, and A. El-Senussi (2014). “Investigating the Predynastic origins of greywacke working in the Wadi Hammamat”. *Archéo-Nil* 24, pp. 11–30.
- Boardman, J. (1980). *The Greeks Overseas: Their Early Colonies and Trade*. London: Thames & Hudson.
- Boccuccia, P., P. Desogus and S. T. Levi (1998). “Il problema dell’uso del tornio tra la fine dell’età del bronzo e la prima età del ferro: ceramica figulina da

- Coppa Nevigata (FG)". In: *Protovillanoviani e/o Protoetruschi: Ricerche e scavi. Atti del Terzo Incontro di Studi, Manciano-Farnese, 12/14 Maggio 1995*. Ed. N. Negroni Catacchio. Florence: Centro Studi di Preistoria e Archeologia Octavo F. Cantini, pp. 249–59.
- Boileau, M. -C. (2005). *Production et distribution céramique au III^e millénaire en Syrie du Nord-est: Une étude technologique des céramiques de Tell 'Atij et Tell Gudedda*. Paris: Editions de la Maison des Sciences de l'Homme.
- Boileau, M. -C., L. Badre, E. Capet, R. Jung and H. Mommsen (2010). "Foreign ceramic tradition, local clays: the handmade burnished ware of Tell Kazel (Syria)". *Journal of Archaeological Science* 37, pp. 1678–89.
- Boivin, N. (2004). "From veneration to exploitation: human engagement with the mineral world". In: *Soils, Stones and Symbols: Cultural Perceptions of the Mineral World*. Ed. N. Boivin and M. A. Owoc. London: University College London Press, pp. 1–29.
- Bonnot, T. (2002). *La vie des objets: D'ustensiles banals à objets de collection*. Paris: Editions de la Maison des Sciences de l'Homme.
- Boulotis, C. (2000). "Travelling fresco painters in the Aegean Late Bronze Age: the diffusion patterns of a prestigious art". In: *The Wall Paintings of Thera: Proceedings of the First International Symposium, P.M. Nomikos Conference Centre, Thera, 30 August–4 September 1997*, vol. 2. Ed. S. Sherratt. Athens: Thera Foundation/Petros M. Nomikos, pp. 844–58.
- Bounni, A., J. Lagarce, E. Lagarce, N. Saliby and L. Badre (1979). "Rapport préliminaire sur la troisième campagne de fouilles (1977) à Ibn Hani (Syrie)". *Syria* 56, pp. 217–94.
- Bouzek, J. (2011). *Prehistory of Europe as Seen from its Centre: Czech Lands from Palaeolithic to the End of the La Tene period in European Context*. Studia Hercynia 15.1. Prague: Charles University Institute for Classical Archaeology.
- Bradley, R. (2000). *An Archaeology of Natural Places*. London: Routledge.
- Bradley, R. and M. Edmonds (1993). *Interpreting the Axe Trade: Production and Exchange in Neolithic Britain*. Cambridge: Cambridge University Press.
- Branigan, K. (1981). "Minoan colonialism". *Annual of the British School at Athens* 76, pp. 23–33.
- Braudel, F. (1972). *The Mediterranean and the Mediterranean World in the Age of Philip II*. New York: Harper & Row.
- (2001). *The Mediterranean in the Ancient World*. English translation. London and New York: Allen Lane.
- Brendel, O. (1978). *Etruscan Art*. New Haven: Yale University Press.
- Briggs-Nash, D. (2006). "Servants at a rich man's feast: early Etruscan household slaves and their procurement". *Etruscan Studies* 9 (2002–3), pp. 153–76.
- (2007). "Home truths from travellers' tales". In: *Communities and Connections: Essays in Honour of Barry Cunliffe*. Ed. C. Gosden, H. Hamerow, P. de Jersey and G. Lock. Oxford: Oxford University Press, pp. 15–29.

- Brill, R. H. (1999). *Chemical Analyses of Early Glasses*, vol. 1 (tables) and 2 (catalogue). Corning, NY: Corning Museum of Glass.
- Brodie, N. (2008). "The donkey: an appropriate technology for early Bronze Age land transport and traction". In: *Horizon: A Colloquium on the Prehistory of the Cyclades*. Ed. N. Brodie, J. Doole, G. Gavalas and C. Renfrew. McDonald Institute Monographs. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, pp. 299–304.
- Brodie, N. and M. Georgakopoulou (2015). "Investigations on Kavos Promontory". In: *Kavos and the Special Deposits*. Ed. C. Renfrew, O. Philaniotou, G. Gavalas, N. Brodie and M. Boyd. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, pp. 507–20.
- Broodbank, C. (2000). *An Island Archaeology of the Early Cyclades*. Cambridge: Cambridge University Press.
- (2004). "Minoanisation". *Proceedings of the Cambridge Philosophical Society* 50.1, pp. 46–91.
- (2006). "The origins and early development of Mediterranean maritime activity". *Journal of Mediterranean Archaeology* 19.2, pp. 199–230.
- (2010). "Ships a-sail from over the Rim of the Sea': voyaging, sailing and the making of Mediterranean societies c. 3500–800 BC". In: *The Global Origins and Development of Seafaring*. Ed. A. Anderson, J. H. Barrett and K. V. Boyle. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, pp. 249–64.
- (2013). *The Making of the Middle Sea: A History of the Mediterranean from the Beginning to the Emergence of the Classical World*. London: Thames & Hudson.
- Broodbank, C. and E. Kiriati (2007). "The first 'Minoans' of Kythera re-visited: technology, demography and landscape in the Early Bronze Age Aegean". *American Journal of Archaeology* 111.2, pp. 241–74.
- Brumfiel, E. and T. Earle (1987). "Specialization, exchange and complex societies: an introduction". In: *Specialization, Exchange, and Complex Societies*. Ed. E. Brumfiel and T. Earle. Cambridge: Cambridge University Press, pp. 1–9.
- Brumm, A. (2010). "The falling sky: symbolic and cosmological associations of the Mt William Greenstone Axe Quarry, Central Victoria, Australia". *Cambridge Archaeological Journal* 20.2, pp. 179–96.
- Brysbaert, A. (2008). *The Power of Technology in the Bronze Age Eastern Mediterranean: The Case of the Painted Plaster*. Monographs in Mediterranean Archaeology 12. London: Equinox.
- Budja, M. (2011). "Early neolithic pots and potters in Western Euroasia". In: *Panonski prapovijesni osviti – Zbornik radova posvećenih Korneliji Minichreiter uz 65. Obljetnicu života*. Ed. M. Dizdar and K. Minichreiter. Zagreb: Institut za arheologiju, pp. 31–67.
- Bunnefeld, J.-H. and S. Schwenzer (2011). "Traditionen, Innovationen und Technologietransfer – zur Herstellungstechnik und Funktion älterbronzezeitlicher Schwerter in Niedersachsen". *Praehistorische Zeitschrift* 86, pp. 207–53.

- Bunnens, G., ed. (2000). *Essays on Syria in the Iron Age*. Ancient Near Eastern Studies Supplement 7. Leuven: Peeters.
- Burns, B. (2010). *Mycenaean Greece, Mediterranean Commerce and the Formation of Identity*. New York: Cambridge University Press.
- Buxeda i Carrigos, J., R. E. Jones, V. Kilikoglou, S. T. Levi, Y. Maniatis, J. Mitchell, L. Vagnetti, K. A. Wardle and S. Andreou (2003). "Technology transfer at the periphery of the Mycenaean world: the cases of Mycenaean pottery found in Central Macedonia (Greece) and the Plain of Sybaris (Italy)". *Archaeometry* 45.2, pp. 263–84.
- Cabana, G. S. and J. J. Clark, eds. (2011). *Rethinking Anthropological Perspectives on Migration*. Gainesville, FL: University Press of Florida.
- Cadogan, G. (1993). "Cyprus, Mycenaean pottery; trade and colonisation". In: *Wace and Blegen: Pottery as Evidence for Trade in the Aegean Bronze Age 1939–1989. Proceedings of the International Conference held at the American School of Classical Studies at Athens, December 2–3, 1989*. Ed. C. W. Zerner, P. C. Zerner and J. Winder. Amsterdam: J. C. Gieben, pp. 91–9.
- Cambitoglou, A. and J. K. Papadopoulos (1993). "The earliest Mycenaean in Macedonia". In: *Wace and Blegen: Pottery as Evidence for Trade in the Aegean Bronze Age 1939–1989. Proceedings of the International Conference held at the American School of Classical Studies at Athens, December 2–3, 1989*. Ed. C. W. Zerner, P. C. Zerner, and J. Winder. Amsterdam: J. C. Gieben, pp. 289–302.
- Cameron, C. (2011). "Captives and culture change: implication for archaeology". *Current Anthropology* 52.2, pp. 169–209.
- Canci, A., D. Contursi and G. Fornaciari (2005). "La necropoli dell'età del bronzo di olmo di Nogara (Verona): primi risultati dello studio palaopatologico". In: *La Necropoli dell'Eta del Bronzo all' Olmo di Nogara*. Ed. L. Salzani. Monograph. Memorie del Museo Civico di Storia Naturale di Verona – 2. Serie sezione science dell'uomo 8. Verona: Museo Civico di Storia Naturale.
- Canci, A., E. Gaspari and C. Maino (2009). "Cutmarks da lama metallica sui resti scheletrici degli armati della necropoli del Bronzo medio e recente di Olmo di Nogara (Verona): traumi inflitti, trapanazioni terapeutiche e lesione postdeposizionali". *Bollettino del Museo Civico di Storia Naturale di Verona. Geologia Paeontologia Preistoria* 33, pp. 133–48.
- Capet, E. (2003). "Tell Kazel (Syrie), Rapport préliminaire sur les 9^e–17^e campagnes de fouilles (1993–2001) du Musée de l'Université de Beyrouth. Chantier II". *Berytus* 47, pp. 63–121.
- (2008). "Les peuples des céramiques 'barbares' à Tell Kazel (Syrie)". In: *Cyprus, the Sea Peoples and the Eastern Mediterranean: Regional Perspectives of Continuity and Change*. Ed. T. P. Harrison. Scripta Mediterranea 27–28 (2006–7). Toronto: Canadian Institute for Mediterranean Studies, pp. 187–207.
- Capet, E. and E. Gubel (2000). "Tell Kazel: six centuries of Iron Age occupation (c.1200–612 B.C.)". In: *Essays on Syria in the Iron Age*. Ed. G. Bunnens. *Ancient Near Eastern Studies Supplement* 7. Leuven: Peeters, pp. 425–58.

- Cardarelli, A. (2004). *Guida al Parco Archeologico e Museo all'aperto della Terramara di Montale*. Modena: Comune, Museo civico archeologico etnologico.
- (2009). "The collapse of the Terramare culture and the growth of new economic and social systems during the Late Bronze Age in Italy". *Scienze dell'Antichità Storia Archeologia Antropologia* 15, pp. 449–520.
- Carpentier, J. and F. Lebrun (1998). *Histoire de la Méditerranée*. Paris: Seuil.
- Carter, T. and V. Kilikoglou (2007). "From reactor to royalty: Aegean and Anatolian obsidians from Quartier Mu, Malia (Crete)". *Journal of Mediterranean Archaeology* 20.1, pp. 115–45.
- Caskey, M., L. Mendoni, A. Papastamataki and N. Beloyannis (1988). "Metals in Keos: a first approach". In: *The Engineering Geology of Ancient Works, Monuments and Historical Sites: Proceedings of the Symposium of the International Association of Engineering Geology, Athens*. Ed. P. G. Marinou and G. C. Koukis. Rotterdam: A. A. Balkema, pp. 1739–45.
- Catapotis, M. (2007). "On the spatial organisation of copper smelting activities in the southern Aegean during the Early Bronze Age". In *Metallurgy in the Early Bronze Age Aegean*. Ed. P. M. Day and R. C. P. Doonan. Sheffield Studies in Aegean Archaeology 7. Oxford: Oxbow Books, pp. 207–23.
- Catapotis, M., O. Pryce and Y. Bassiakos (2008). "Preliminary results from an experimental study of perforated copper-smelting shaft furnaces from Chrysokamino (Eastern Crete)". In: *Aegean Metallurgy in the Bronze Age: Proceedings of an International Symposium held at the University of Crete, Rethymnon, Greece on November 19–21, 2004*. Ed. I. Tzachili. Athens: Ta Pragmata Publications, pp. 113–21.
- Catapotis, M., Y. Bassiakos and Y. Papadatos (2011). "Reconstructing early Cretan metallurgy: analytical evidence from Kephala Petras, Siteia". In: *Metallurgy: Understanding How, Learning Why. Studies in Honour of James D. Muhly*. Ed. P. P. Betancourt and S. C. Ferrence. Prehistory Monographs 29. Philadelphia: INSTAP Academic Press, pp. 69–78.
- Caton-Thompson, G. and E. W. Gardner (1934). *The Desert Fayum*, vols. 1 and 2. London: Royal Anthropological Institute.
- Cavanagh, W. G. and C. B. Mee (1999). "Building the Treasury of Atreus". In: *Meletemata: Studies in Aegean Archaeology Presented to Malcolm H. Wiener as he Enters his 65th Year*. Ed. P. P. Betancourt, V. Karageorghis, R. Laffineur and W.-D. Niemeier. Aegaeum 20. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 93–102.
- Cazzella, A. (1996). "La Puglia come area periferica del Mondo Miceneo: Il Caso di Coppa Nevigata". In: *Atti e Memorie del Secondo Congresso Internazionale di Micenologia. Roma–Napoli, 14–20 ottobre 1991*, vol. 3. *Archeologia*. Ed. E. De Miro, L. Godart and A. Sacconi. Rome: Gruppo Editoriale Internazionale, pp. 1543–9.
- Cazzella, A. and G. Recchia (2009). "The 'Mycenaeans' in the central Mediterranean: a comparison between the Adriatic and the Tyrrhenian seaways". *Pasiphae: Revista di filologia e antichità* Egee 3, pp. 27–40.

- (2012). "Malta, Sicily and southern Italy during the Bronze Age: the meaning of a changing relationship". In: *Exchange Networks and Local Transformations: Interaction and Local Change in Europe and the Mediterranean from the Bronze Age to the Iron Age*. Ed. M. E. Alberti and S. Sabatini. Oxford and Oakville, CT: Oxbow Books, pp. 70–81.
- Celestino, S., N. Rafael and X.-L. Armada, eds. (2008). *Contacto cultural entre el Mediterráneo y Atlántico (siglos XII-VIII a.n.e.): La precolonización a debate*. Serie Arqueológica 11. Madrid: Consejo Superior de Investigaciones Científicas Escuela Española de Historia y Arqueología en Roma.
- Chanut, C. (2000). *Bois, pierres et métaux à Ugarit-Ras Shamra*. Paris: Atelier National de Réproduction de Thèses.
- Chapman, J. (2006). "Dark burnished ware as sign: ethnicity, aesthetics and categories in the Later Neolithic of the Central Balkans". In: *Homage to Milutin Garašanin*. Ed. N. Tasić and C. Grozdanov. Beograd: Serbian Academy of Sciences and Arts, Macedonian Academy of Sciences and Arts, pp. 295–308.
- Chapman, J., B. Gaydarska, E. Skafida and S. Souvatzis (2011). "Personhood and the life cycle of spondylus rings: an example from Late Neolithic, Greece". In: *Spondylus in Prehistory: New Data and Approaches. Contributions to the Archaeology of Shell Technologies*. Ed. F. Ifantidis and M. Nikolaidou. British Archaeological Reports International Series 2216. Oxford: Archaeopress, pp. 139–60.
- Chenery, C. A. and J. A. Evans (2011). "A summary of the strontium and oxygen isotope evidence for the origin of Bell Beaker individuals found near Stonehenge". In: *The Amesbury Archer and the Boscombe Bowmen: Bell Beaker Burials at Boscombe Down, Amesbury, Wiltshire*. Ed. A. P. Fitzpatrick. Great Britain: Excavations at Boscombe Down 1. Wessex Archaeology Report 27. Salisbury: Wessex Archaeology, pp. 185–90.
- Childe, V. G. (1929). *The Danube in Prehistory*. Oxford: Clarendon Press.
- Childs, S. T. and D. Killick (1993). "Indigenous African metallurgy: nature and culture". *Annual Review of Anthropology* 22, pp. 317–37.
- Chlouveraki, S. (2002). "Exploitation of gypsum in Minoan Crete". In: *ASMOSIA VI: Interdisciplinary Studies on Ancient Stone. Proceedings of the Sixth International Conference of the Association for the Study of Marble and other Stones in Antiquity, Venice, June 15–18 2000*. Ed. L. Lazzarini. Padua: Bottega D'Erasmio, pp. 25–34.
- (2006). *Gypsum in Minoan Architecture: Exploitation, Utilisation and Weathering of a Prestige Stone*. PhD Thesis. University College London.
- Chrysikopoulou, E., V. Kilikoglou, V. Perdikatsis, S. Sotiropoulou, K. Birtacha and M. Zacharioudakis (2000). "Making wall paintings: an attempt to reproduce the painting techniques of Bronze Age Thera". In: *The Wall Paintings of Thera: Proceedings of the First International Symposium, P. M. Nomikos Conference Centre, Thera, 30 August–4 September 1997*, vol. 1. Ed. S. Sherratt. Athens: Thera Foundation/Petros M. Nomikos, pp. 119–29.

- Cianciolo, A. T., E. L. Grigorenko, L. Jarvin, G. Gil, M. E. Drebot and R. J. Sternberg (2006). "Practical intelligence and tacit knowledge: advances in the measurement of developing expertise". *Learning and Individual Differences* 16.3, pp. 235–53.
- Clarke, D. (1973). "Archaeology: the loss of innocence". *Antiquity* 47, pp. 6–18.
- Clifford, J. (1997). *Routes. Travel and Translation in the Late Twentieth Century*. Cambridge, MA: Harvard University Press.
- Cline, E. H. (1991). "A possible Hittite embargo against the Mycenaeans". *Historia: Zeitschrift für Alte Geschichte* 40.1, pp. 1–9.
- (1995). "Tinker, tailor, soldier, sailor: Minoans and Mycenaeans abroad". In: *POLITEIA: Society and State in the Aegean Bronze Age. Proceedings of the 5th International Aegean Conference/5e Rencontre égéenne internationale, University of Heidelberg, Archäologisches Institut, 10–13 April 1994*. Aegaeum 12. Ed. R. Laffineur and W.-D. Niemeier. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 265–87.
- (2007). "Rethinking Mycenaean international trade with Egypt and the Near East". In: *Rethinking Mycenaean Palaces II*. Revised and expanded edn. Ed. M. L. Galaty and W. A. Parkinson. Los Angeles Monograph Series 60. Los Angeles: The Cotsen Institute of Archaeology, University of California, pp. 190–201.
- Cline, E. H., ed. (2010). *The Oxford Handbook of the Bronze Age Aegean (ca.3000–1000 BC)*. Oxford: Oxford University Press.
- Cohen, R. and R. Westbrook, eds. (2000). *Amarna Diplomacy: The Beginnings of International Relations*. Baltimore: Johns Hopkins University Press.
- Cohen, C. R., Th. Rehren and M. van Buren (2009). "When the wind blows: environmental adaptability in current day silver production within the Bolivian Andes". In: *Proceedings of the 36th International Symposium on Archaeometry, 2–6 May 2006, Québec City, Canada*. Ed. J. F. Moreau, R. Auger, J. Chabot and A. Herzog. Cahiers d'Archéologie du CELAT 25. Québec: CELAT, Université Laval, pp. 465–475.
- Coleman, J. E. (1977). *Keos I: Kephala. A Late Neolithic Settlement and Cemetery*. Princeton: Princeton University Press.
- Colledge, S. and J. Conolly, eds. (2007). *The Origins and Spread of Domestic Plants in Southwest Asia and Europe*. Walnut Creek, CA: Left Coast Press.
- Colledge, S., J. Conolly, K. Dobney, K. Manning and S. Shennan, eds. (2013). *The Origins and Spread of Domestic Animals in Southwest Asia and Europe*. Walnut Creek, CA: Left Coast Press.
- Coldstream, J. N. and G. L. Huxley, eds. (1972). *Kythira: Excavations and Studies Conducted by the University of Pennsylvania Museum and the British School at Athens*. London: Faber & Faber.
- Conophagos, K. (1980). *To Archaio Lavrio kai I Elliniki Techniki Paragogis tou Argyrou*. Athens: Ekdotiki.

- Cooney, G. (1998). "Breaking stones, making places: the social landscape of axe production sites". In: *Prehistoric Ritual and Religion*. Ed. A. Gibson and D. Simpson. Stroud: Sutton Publishing, pp. 108–18.
- (1999). "Social landscapes in Irish prehistory". In: *The Archaeology and Anthropology of Landscape: Shaping your Landscape*. Ed. P. Ucko and R. Layton. London: Routledge, pp. 46–64.
- Coppa, A., A. Cucina, M. Lucci, D. Mancinelli and R. Vargiu (2007). "Origins and spread of agriculture in Italy: a nonmetric dental analysis". *American Journal of Physical Anthropology* 133, pp. 918–30.
- Corniquet, C. (2011). "Cadres de pratiques et circulation des connaissances chez les potières de l'Arewa (Niger)". *Cahiers d'Etudes Africaines* 201, pp. 87–114.
- (2014). Ancre social, ancre spatial. Circulation des savoirs céramiques chez les potières de l'Arewa et du Kurey (Niger). Unpublished PhD Thesis. Université libre de Bruxelles.
- Costin, C. L. (1991). "Craft specialization: issues in defining, documenting, and explaining the organization of production". In: *Archaeological Method and Theory*, vol. 3. Ed. M. B. Schiffer. Tucson, AZ: University of Arizona Press, pp. 1–56.
- Courty, M. A. and V. Roux (1995). "Identification of wheel throwing on the basis of ceramic surface features and microfabrics". *Journal of Archaeological Science* 22.1, pp. 17–50.
- Couyat, J. and P. Montet (1912). *Les Inscriptions hiéroglyphiques et hiératiques du Ouâdi Hammâmât*. Mémoires pub. Par les membres de l'Institut Français d'Archéologie Orientale du Caire 34. Cairo: Imprimerie de L'Institut Français et Archéologie Orientale.
- Coward, F. (2008). "Standing on the shoulders of giants". *Science* 319 (14 March), pp. 1493–5.
- Coy, M. W., ed. (1989). *Apprenticeship: From Theory to Method and Back Again*. Albany, NY: State University of New York Press.
- Craddock, P. T. (2001). "From hearth to furnace: evidences for the earliest metal smelting technologies in the Eastern Mediterranean". *Paléorient* 26, pp. 151–65.
- Cremaschi, M., C. Pizzi and V. Valsecchi (2006). "Water management and land use in the terramare and a possible climatic co-factor in their abandonment: the case study of the terramare of Poviglio Santa Rosa (northern Italy)". *Quaternary International* 151, pp. 87–98.
- Cresswell, R. (1996). *Prométhée ou Pandore? Propos de technologie culturelle*. Paris: Éditions Kimé.
- Cresswell, T. (2011). "Mobilities I: catching up". *Progress in Human Geography* 35.4, pp. 550–8.
- Crewe, L. (2007). "Sophistication in simplicity: the first production of wheelmade pottery on Late Bronze Age Cyprus". *Journal of Mediterranean Archaeology* 20.2, pp. 209–38.
- Crewe, L. and C. Knappett (2012). "Technological innovation and island societies: wheelmade pottery on Bronze and Iron Age Crete and Cyprus". In: *Parallel*

- Lives: Ancient Island Societies in Crete and Cyprus*. Ed. G. Cadogan, M. Iacovou, K. Kopaka and J. Whitley. British School at Athens Studies 20. London: British School at Athens, pp. 175–85.
- Crown, P. L. (2001). “Learning to make pottery in the prehispanic American Southwest”. *Journal of Anthropological Research* 57, pp. 451–69.
- Cucchi, T., J.-D. Vigne and J.-C. Auffray (2005). “First occurrence of the house mouse (*Mus musculus domesticus* Schwarz and Schwarz, 1943) in the western Mediterranean: a zooarchaeological revision of subfossil occurrences”. *Biological Journal of the Linnean Society* 84, pp. 429–45.
- Cunliffe, B. (2001). *The Extraordinary Voyage of Pytheas the Greek: The Man who Discovered Britain*. London: Allen Lane.
- Cupitò, M. (2006). *Tipocronologia del Bronzo Medio e Recente tra l'Adige e il Mincio sulla Base delle Evidenze Funerarie*. Saltuarie dal laboratorio del Piovego 7. Padova: Imprimitur.
- (2011). “Micenei in Italia settentrionale”. In: *Le grandi vie delle civiltà: Relazioni e scambi fra Mediterraneo il Centro Europa dalla Preistoria alla Romanità. Mostra Trento, Castello del Buonconsiglio, 1 giugno–13 novembre 2011*. Ed. F. Marzatico, R. Gebhard and P. Gleirscher. Trento: Castello del Buonconsiglio, pp. 193–7.
- Cupitò, M., E. Dalla Longa, V. Donadel and G. Leonardi (2012). “Resistances to the 12th century BC crisis in the Veneto region: the case studies of Fondo Paviani and Montebello Vicentino”. In: *Collapse or Continuity? Environment and Development of Bronze Age Human Landscapes*. Ed. J. Kneisel, W. Kirleis, M. Dal Corso, N. Taylor and V. Tiedtke. Universitätsforschungen zur prähistorischen Archäologie 205. Bonn: Dr. Rudolf Habelt, pp. 55–70.
- Cutler, J. (2011). *Crafting Minoanisation: Textiles, Craft Production and Social Dynamics in the Bronze Age Southern Aegean*. PhD Thesis. University College London.
- Czebreszuk, J. (2011). *Bursztyn w kulturze mykenskiej: Zarys problematyki badawczej* (summary: amber in Mycenaean culture). Poznań: Wydawnictwo Poznańskie.
- D'Agata, A. L., M.-C. Boileau and S. De Angelis (2012). “Handmade burnished ware from the island of Crete: a view from the inside”. *Rivista di Scienze Preistoriche* 62, pp. 275–310.
- Darcque, P. (2005). *L'habitat mycénien: Formes et fonctions de l'espace bâti en Grèce continentale à la fin du IIe millénaire avant J.-C.* Bibliothèque des Écoles Françaises d'Athènes et de Rome 319. Athens: École Française d'Athènes.
- David, W. (2009). “Nascita e crollo della civiltà dei Tell dell'antica età del Bronzo nel Bacino Carpatico ed indizi di possibili, analoghi fenomeni culturali coevi nella regione dell'alto e medio Danubio nella prima metà dell II millennio A.C.”. *Scienze dell'antichità Storia Archeologia Antropologia* 15, pp. 563–94.
- Davis, J. L. and E. Gorogianni (2008). “Potsherds from the edge: the construction of identities and the limits of Minoanized areas of the Aegean”. In: *Horizon: A Colloquium on the Prehistory of the Cyclades*. Ed. N. Brodie,

- J. Doole, G. Gavalas and C. Renfrew. McDonald Institute Monographs. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, pp. 339–48.
- Day, P. M. and R. C. P. Doonan (2007). *Metallurgy in the Early Bronze Age Aegean*. Sheffield Studies in Aegean Archaeology 7. Oxford: Oxbow Books.
- Degryse, P., A. Boyce, N. Erb-Satullo, K. Eremin, S. Kirk, B. Scott, A. Shortland, J. Schneider and M. Walton (2010). “Isotopic discriminants between Late Bronze Age glasses from Egypt and the Near East”. *Archaeometry* 52.3, pp. 380–8.
- de la Cruz, J. C. M. (1987). “Ceramicas micénicas en Andalucía?”. *Revista di Arqueologia* 8, pp. 62–4.
- Depauw, M. (2009). “The semiotics of quarry marks applied to Late Period and Graeco-Roman Egypt”. In: *Non-textual Marking Systems, Writing and Pseudo Script from Prehistory to Modern Times*. Ed. P. Andrassy, J. Budka and F. Kammerzell. Göttingen: Seminar für Ägyptologie und Koptologie, pp. 205–13.
- de Vries, D. J. (2009). “Signs and symbols on architecture: building history in the Low Countries during the Middle Ages”. In: *Pictograms or Pseudo Script? Non-Textual Identity Marks in Practical Use in Ancient Egypt and Elsewhere. Proceedings of a Conference in Leiden, 19–20 December 2006*. Ed. B. J. J. Haring and O. E. Kaper. Leuven: Peeters, pp. 211–20.
- Dickinson, O. T. P. K. (1977). *The Origins of Mycenaean Civilization*. Göteborg: Paul Åströms Förlag.
- (1994). *The Aegean Bronze Age*. Cambridge World Archaeology. Cambridge: Cambridge University Press.
- Dickinson, T. (2014). A Landscape and Materials-based Approach to Royal Mortuary Architecture in Early Third Millennium BC Egypt. PhD Thesis. University College London.
- Dietler, M. (2010). *Archaeologies of Colonialism: Consumption, Entanglement, and Violence in Ancient Mediterranean France*. Joan Palevsky imprint in classical literature. Berkeley, CA: University of California Press.
- Dietrich, L. (2010). “Eliten der frühen und mittleren Bronzezeit im südöstlichen Karpatenbecken”. *Praehistorische Zeitschrift* 85, pp. 191–206.
- Dimitriadis, S., (2002). “Petrographika charactiristika tis keramikis”. In: *Dispilio 7500 chronia meta*. Ed. G. Ch. Chourmouziadis. Thessaloniki: University Studio Press, pp. 243–6.
- Dimitriadis, S. and K. Skourtopoulou (2003). “Petrographic Examination of Chipped Stone Materials”. In: *Prehistoric Sitagroi: Excavations in Northeast Greece, 1968–1970, vol. 2. The Final Report*. Ed. E. Elster and C. Renfrew. Monumenta Archaeologica 20. Los Angeles: Cotsen Institute of Archaeology at the University of California, pp. 127–32.
- Dimitrijević, V. and B. Tripković (2006). “Spondylus and Glycymeris bracelets trade reflections at Neolithic Vinča-Belo Brdo”. *Documenta Praehistorica* 33, pp. 237–52.
- Dobres, M. -A. (2000). *Technology and Social Agency: Outlining a Practice Framework for Archaeology*. Oxford: Blackwell.

- Douka, K. (2011). "The contribution of archaeometry to the study of prehistoric marine shells". In *Spondylus in Prehistory: New Data and Approaches – Contributions to the Archaeology of Shell Technologies*. Ed. F. Ifantidis and M. Nikolaidou. British Archaeological Reports International Series 2216. Oxford: Archaeopress, pp. 171–80.
- Doumas, C. G. (2011). "Searching for the Early Bronze Age Aegean metallurgist's toolkit". In: *Metallurgy: Understanding How, Learning Why. Studies in Honour of James D. Muhly*. Ed. P. P. Betancourt and S. C. Ferrence. Prehistory Monographs 29. Philadelphia: INSTAP Academic Press, pp. 165–79.
- Driessen, J. (1984). "The ammoudha quarries at Ta Skaria". *Annual of the British School at Athens* 79, pp. 144–9.
- Driessen, J. and I. Schoep (1999). "The stylus and the sword: the roles of scribes and warriors in the conquest of Crete". In: *POLEMOS. Le Contexte Guerrier en Égée à l'Âge du Bronze. Actes de la 7e Rencontre égéenne internationale, Université de Liège, 14–17 avril 1998*. Ed. R. Laffineur. Aegaeum 19. Liège and Austin, TX: Université de Liège Histoire de l'art et archéologie de la Grèce antique and University of Texas, Program in Aegean Scripts and Prehistory, pp. 389–401.
- Dubertret, L. (1962). *Carte Géologique du Liban, Syrie et Bordure des Pays Voisins, 1:100.000*. Paris: Museum National D'Histoire Naturelle.
- Duerr, H. P. (2011). *Die Fahrt der Argonauten*. Berlin: Insel-Verlag.
- Dziegielewski, K., M. S. Przybyła and A. Gawlik, eds. (2010). *Migration in Bronze and Early Iron Age Europe*. Krakow: Prace Archeologiczne 63 Studies..
- Earle, T. (2002). *Bronze Age Economics: The Beginnings of Political Economies*. Boulder, CO, and Oxford: Westview Press.
- Earle, T. and K. Kristiansen (2010a). "Organizing Bronze Age societies: concluding thoughts". In: *Organizing Bronze Age Societies: The Mediterranean, Central Europe and Scandinavia Compared*. Ed. T. Earle and K. Kristiansen. Cambridge: Cambridge University Press, pp. 218–56.
- Earle, T. and K. Kristiansen, eds. (2010b). *Organizing Bronze Age Societies. The Mediterranean, Central Europe and Scandinavia Compared*. Cambridge: Cambridge University Press.
- Earle, T. and C. Gamble, with H. Poinar (2011). "Migration". In: *Deep History: The Architecture of Past and Present*. Ed. A. Shyrock and D. Lord Smail. Berkeley, CA: University of California Press, pp. 191–218.
- Edgerton, D. (2006). *The Shock of the Old: Technology and Global History since 1900*. London: Profile Books.
- Edmonds, M. (1999). *Ancestral Geographies of the Neolithic: Landscapes, Monuments and Memory*. London and New York: Routledge.
- Ekholm Friedman, K. and J. Friedman (2008). *Historical Transformations. The Anthropology of Global Systems*. Lanham, MD: Altamira Press.
- Ellis, S. E., R. Hope Simpson and R. H. Higgins (1968). "The façade of the Treasury of Atreus at Mycenae". *Annual of the British School at Athens* 63, pp. 331–6.

- Epstein, S. R. (2004). "Property rights to technical knowledge in premodern Europe, 1300–1800". *American Economic Review* 94, pp. 382–7.
- Ericsson, K. A., R. T. Krampe and C. Tesch-Romer (1993). "The role of deliberate practice in the acquisition of expert performance". *Psychological Review* 100.3, pp. 363–406.
- Eyre, C. J. (1987). "Work and the organisation of work in the Old Kingdom". In: *Labor in the Ancient Near East*. Ed. M. A. Powell. New Haven: American Oriental Society, pp. 5–47.
- Fahlander, F. and A. Kjellström, eds. (2010). *Making Sense of Things: Archaeologies of Sensory Perception*. Stockholm Studies in Archaeology 53. Stockholm: Stockholm University.
- Ferrara, S. (2012). *Cypro-Minoan Inscriptions*. Oxford: Oxford University Press.
- Feuer, B. (2011). "Being Mycenaean: A view from the periphery". *American Journal of Archaeology* 115.4, pp. 507–36. doi: 10.3764/aja.115.4.0507.
- Finkelberg, M. (1998). "Bronze Age writing: contacts between East and West". In: *The Aegean and the Orient in the Second Millennium. Proceedings of the 50th Anniversary Symposium Cincinnati, 18–20 April 1997*. Ed. E. H. Cline and D. Harris-Cline. Aegaeum 18. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 265–72.
- Fitzsimons, R. D. (2011). "Monumental architecture and the construction of the Mycenaean state". In: *State Formation in Italy and Greece: Questioning the Neoevolutionist Paradigm*. Ed. N. Terrenato and D. C. Haggis. Oxford and Oakville, CT: Oxbow Books, pp. 75–118.
- Flood, F. B. (2009). *Objects of Translation: Material Culture and Medieval 'Hindu-Muslim' Encounter*. Princeton: Princeton University Press.
- Fotiadis, M., A. Hondroyanni-Metoki, A. Kalogirou and Ch. Ziota (2000). "Megalo Nisi Galanis (Kitrini Limni basin) and the Later Neolithic of northwestern Greece". In: *Karanovo*, vol. 3. *Beiträge zum Neolithikum in Südosteuropa*. Ed. S. Hiller and V. Nikolov. Wien: Phoibos Verlag, pp. 217–28.
- French, C. (2010). "The Paleo-Environments of Bronze Age Europe". In: *Organizing Bronze Age Societies: The Mediterranean, Central Europe and Scandinavia Compared*. Ed. T. Earle and K. Kristiansen. Cambridge: Cambridge University Press, pp. 34–56.
- Fuchs, F. (2009). "Über die Steinmetzzeichen am Regensburger Dom und darüber hinaus". In: *Non-Textual Marking Systems, Writing and Pseudo Script from Prehistory to Modern Times*. Ed. P. Andrassy, J. Budka and F. Kammerzell. Göttingen: Seminar für Ägyptologie und Koptologie, pp. 233–54.
- Fugazzola Delpino, M. A. and M. Mineo (1995). "La piroga Neolitica del Lago di Bracciano, La Marmotta". *Bollettino di Paleontologia Italiano* 86, pp. 197–266.
- Fullagar, R. and L. Head (1999). "Exploring the prehistory of hunter-gatherer attachments to place: an example from the Keep River Area, Northern Territory, Australia". In: *The Archaeology and Anthropology of Landscape: Shaping your*

- Landscape*. Ed. P. Ucko and R. Layton. London and New York: Routledge, pp. 322–35.
- Furumark, A. (1972). *Mycenaean Pottery*, vol. 1. *Analysis and Classification*; vol. 2. *Chronology*. Skrifter utgivna av Svenska institutet i Athen 20. Stockholm: Svenska Institutet i Athen.
- Galaty, M. (2010). “Wedging clay: combining competing models of Mycenaean pottery industries”. In: *Political Economies of the Aegean Bronze Age: Papers from the Langford Conference, Florida State University, Tallahassee, 22–24 February 2007*. Ed. D. J. Pullen. Oxford and Oakville, CT: Oxbow Books, pp. 230–47.
- Galaty, M. L. and W. A. Parkinson, eds. (2007). *Rethinking Mycenaean Palaces II*. Revised and expanded edn. Los Angeles Monograph Series 60. Los Angeles: Cotsen Institute of Archaeology, University of California.
- Gale, N. H. and Z. A. Stos-Gale (1981). “Cycladic lead and silver metallurgy”. *Annual of the British School at Athens* 76, pp. 169–224.
- (2002). “Archaeometallurgical research in the Aegean”. In: *The Beginnings of Metallurgy in the Old World*. Ed. M. Bartelheim, E. Pernicka and R. Krause. Forschungen zur Archäometrie und Altertumswissenschaft 1. Rahden/Westf.: Verlag Marie Leidorf, pp. 277–302.
- (2008). “Changing patterns in prehistoric Cycladic metallurgy”. In: *Horizon: A Colloquium on the Prehistory of the Cyclades*. Ed. N. Brodie, J. Doole, G. Gavalas and C. Renfrew. McDonald Institute Monographs. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, pp. 387–408.
- Gale, N. H., A. Papastamatakis, Z. A. Stos-Gale and K. Leonis (1985). “Copper sources and copper metallurgy in the Aegean Bronze Age”. In: *Furnaces and Smelting Technology in Antiquity*. British Museum Occasional Paper 48. Ed. P. T. Craddock and M. J. Hughes. London: British Museum, pp. 81–101.
- Gale, N. H., H. C. Einfalt, H. W. Hubberten and R. E. Jones (1988). “The sources of Mycenaean gypsum”. *Journal of Archaeological Science* 15.1, pp. 57–72.
- Gale, N. H., M. Kayafa, and Z. A. Stos-Gale (2008). “Early Helladic metallurgy at Raphina, Attica, and the role of Lavrion”. In: *Aegean Metallurgy in the Bronze Age: Proceedings of an International Symposium held at the University of Crete, Rethymnon, Greece on November 19–21, 2004*. Ed. I. Tzachili. Athens: Ta Pragmata Publications, pp. 87–104.
- Gardner, E. (2003). “Technical Analysis of the Ceramics”. In: *Prehistoric Sitagroi: Excavations in Northeast Greece, 1968–1970*, vol. 2. *The Final Report*. Ed. E. Elster and C. Renfrew. Monumenta Archaeologica 20. Los Angeles: Cotsen Institute of Archaeology at the University of California, pp. 283–95.
- Gauss, W. (2010). “Aegina Kolonna”. In: *The Oxford Handbook of the Bronze Age Aegean (ca. 3000–1000BC)*. Ed. E. H. Cline. Oxford: Oxford University Press, pp. 738–51.
- Gauss, W. and E. Kiriati (2011). *Pottery Production and Supply at Bronze Age Kolonna, Aegina: An Integrated Archaeological and Scientific Study of a Ceramic*

- Landscape*. Ägina Kolonna, Forschungen und Ergebnisse 5. Contributions to the Chronology of the Eastern Mediterranean. Vienna: Österreichische Akademie der Wissenschaften.
- Gell, A. (1985). "How to read a map: remarks on the practical logic of navigation". *Man* 20, pp. 271–86.
- Georgakopoulou, M. (2007a). "The metallurgical remains". In: *Keros, Dhaskalio Kavos: The Investigations of 1987–88*. Ed. A. C. Renfrew, C. Doumas, L. Marangou and G. Gavalas. McDonald Institute Monographs. Keros 1. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, pp. 380–401.
- (2007b). "Metallurgical activities within Early Cycladic settlements: the case of Daskalio-Kavos". In: *Metallurgy in the Early Bronze Age Aegean*. Ed. P. M. Day and R. C. P. Doonan. Sheffield Studies in Aegean Archaeology 7. Oxford: Oxbow Books, pp. 123–34.
- (2013). "Metal artefacts and metallurgy". In: *The Sanctuary on Keros and the Origins of Aegean Ritual Practice: The Excavations of 2006–2008*, vol. 1. *The Settlement at Dhaskalio*. Ed. A. C. Renfrew, O. Philaniotou, G. Gavalas, N. Brodie and M. Boyd. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, pp. 667–92.
- (in press a). "Lead isotope analysis and metal production models for the Bronze Age Aegean". In: *Prehistoric Metal Production in the Aegean: Material Evidence and Analysis*. Ed. Y. Bassiakos. Heidelberg: Springer Verlag.
- (in press b). "Metal and metallurgical remains". In: *The Keros Island Survey*. Ed. C. Renfrew, M. Marthari, K. Dellaporta, M. J. Boyd, N. J. Brodie, G. Gavalas, J. Hilditch and J. Wright. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge.
- (in press c). "Metal production, working and consumption across the sites at Dhaskalio and Kavos". In: *The Sanctuary on Keros and the Origins of Aegean Ritual Practice: The Excavations of 2006–2008*, vol. III: *The Marble Finds from Kavos and the Archaeology of Ritual*. Ed. A. C. Renfrew, O. Philaniotou, G. Gavalas, N. Brodie and M. Boyd. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge.
- Georgakopoulou, M., Y. Bassiakos and O. Philaniotou (2011). "Seriphos surfaces: a study of copper slag heaps and copper sources in the context of Early Bronze Age Aegean metal production". *Archaeometry* 53, pp. 123–45.
- Georgiadis, M. (2008). "The obsidian in the Aegean beyond Melos: an outlook from Yali". *Oxford Journal of Archaeology* 27, pp. 101–17.
- Georma, F. (2009). *The Wall Paintings of Building B from the Prehistoric Settlement of Akrotiri Thera*. Unpublished PhD Thesis. University of Ioannina (in Greek).
- Giannopoulos, T. (2008). *Die letzte Elite der mykenischen Welt: Achaia in mykenischer Zeit und das Phänomen der Kriegerbestattungen im 12.–11. Jahrhundert v. Chr.* Universitätsforschungen zur prähistorischen Archäologie 152. Bonn: Habelt.
- Giblin, J. I., K. J. Knudson, Z. Bereczki, G. Pálfi and I. Pap (2013). "Strontium isotope analysis and human mobility during the Neolithic and Copper Age: a

- case study from the Great Hungarian Plain". *Journal of Archaeological Science* 40, pp. 227–39.
- Goedicke, H. (1984). "Abi-Sha(i)'s representation in Beni Hasan". *Journal of the American Research Center in Egypt* 21, pp. 203–10.
- Goetze, B.-R. (1984). "Die frühesten europäischen Schutzwaffen. Anmerkungen zum Zusammenhang einer Fundgattung". *Bayerische Vorgeschichtsblätter* 49, pp. 25–53.
- Gorogianni, E. P., P. Pavuk and L. Girella, eds. (2016). *Beyond Thalassocracies: Understanding processes of Minoanisation and Mycenaeanisation in the Aegean*. Oxford: Oxbow books.
- Gosden, C. and Y. Marshall (1999). "The cultural biography of objects". *World Archaeology* 31.2, pp. 169–78.
- Gosselain, O. P. (2000). "Materialising identities: an African perspective". *Journal of Archaeological Method and Theory* 7.3, pp. 187–217.
- (2002). *Poteries du Cameroun: Méridional styles techniques et rapports à l'identité*. CRA Monographies 26. Paris: CNRS Editions.
- (2008). "Mother Bella was not a Bella: inherited and transformed traditions in southwestern Niger". In: *Cultural Transmission and Material Culture: Breaking Down Boundaries*. Ed. M. T. Stark, B. J. Bowser and L. Horne. Tucson, AZ: University of Arizona Press, pp. 150–77.
- (2010). "Exploring the dynamics of African pottery cultures". In: *The Archaeology of Regional Technologies: Case Studies from the Palaeolithic to the Age of the Vikings*. Ed. R. Barndon, A. Engevik and I. Øye. Lewiston, NY: Edwin Mellen Press, pp. 193–224.
- (2011). "Fine if I do, fine if I don't: dynamics of technical knowledge in sub-Saharan Africa". In: *Investigating Archaeological Cultures: Material Culture, Variability and Transmission*. Ed. B. W. Roberts and M. Vander Linden. New York: Springer Science+Business Media, pp. 211–27.
- (2015). "Roads, markets, migrants: the historical trajectory of a male Hausa pottery tradition in southern Niger". In: *The Distribution of Technological Knowledge in the Production of Ancient Mediterranean Pottery*. Ed. W. Gauß, G. Klebinder-Gauß, and C. von Rüden. Vienna: Sonderschriften ÖAI, pp. 277–96.
- Gosselain, O., R. Zeebroek and J.-M. Decroly (2008). "Les tribulations d'une casse-
role chinoise au Niger". *Techniques et Culture* 51, pp. 18–49.
- Grammenos, D. (1991). *Neolithikes Erevnes stin Kentriki kai Anatoliki Makedonia*. Athens: Library of the Archaeological Society at Athens 117.
- Grenne, T., T. Heldal, G. B. Meyer and E. Bloxam (2008). "From Hyllestad to Selbu: Norwegian millstone quarrying through 1300 years". In: *Geology for Society*. Ed. T. Slagstad. Geological Survey of Norway Special Publication 11. Trondheim: NGU Geological Survey of Norway, pp. 47–66.
- Grenon, M. and M. Batisse, eds. (1989). *Futures for the Mediterranean Basin: The Blue Plan*. Oxford and New York: Oxford University Press.

- Grove, A. T. and O. Rackham (2001). *The Nature of Mediterranean Europe: An Ecological History*. London and New Haven: Yale University Press.
- Haaland, R. (1978). "Ethnographical observations of pottery-making in Darfur, Western Sudan, with some reflections on archaeological interpretation". In: *New Directions in Scandinavian Archaeology*. Ed. K. Kristiansen and C. Poludan-Müller. Copenhagen: National Museum of Denmark, pp. 47–61.
- Habachi, L. (1965). "Varia: from the Reign of King Akhenaten". *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 20, pp. 70–91.
- Habu, J. (2010). "Seafaring and the development of cultural complexity in north-east Asia: evidence from the Japanese archipelago". In: *The Global Origins and Development of Seafaring*. Ed. A. Anderson, J. H. Barrett and K. V. Boyle. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, pp. 159–70.
- Hadjianastasiou, O. (1998). "Notes from Kythnos". In: *Kea-Kythnos: History and Archaeology. Proceedings of an International Symposium Kea-Kythnos, 22–25 June 1994*. Ed. L. G. Mendoni and A. J. Mazarakis Ainian. Meletemata 27. Athens: KERA-EIE, pp. 259–73 (in Greek).
- Hadjianastasiou, O. and S. MacGillivray (1988). "An Early Bronze Age smelting site on the Aegean island of Kythnos. Part two: the archaeological evidence". In: *Aspects of Ancient Mining and Metallurgy: Acts of a British School at Athens Centenary Conference at Bangor, 1986*. Ed. J. E. Jones. Bangor: Department of Classics, University College of North Wales, pp. 31–4.
- Haensel, B. and I. Aslanis (2010). *Das Prähistorische Olynth, Ausgrabungen in der Tumba Agios Mamas 1994–96: Die Grabung und der Baubefund*. Prähistorische Archäologie in Südosteuropa 23. Rahden: Verlag Marie Leidorf.
- Hägg, R. (1982). "On the nature of the Minoan influence in early Mycenaean Messenia". *Opuscula Atheniensia* 24.4, pp. 27–37.
- Haggis, D. C. (2006). "Chrysokamino in context: a regional archaeological survey". In: *The Chrysokamino Metallurgy Workshop and its Territory*. Ed. P. P. Betancourt. Hesperia Supplement 36. Princeton: American School of Classical Studies at Athens, pp. 221–32.
- Halperin, C. T. (2014). "Circulation as placemaking: Late Classic Maya polities and portable objects". *American Anthropologist* 116.1, pp. 110–29.
- Halstead, P. (1988). "On redistribution and the origin of Minoan-Mycenaean palatial economies". In: *Problems in Greek Prehistory: Papers Presented at the Centenary Conference of the British School of Archaeology at Athens, Manchester, April 1986*. Ed. E. French and K. Wardle. Bristol: Bristol Classical Press, pp. 519–30.
- (1989). "The economy has a normal surplus: economic stability and social change among early farming communities of Thessaly, Greece". In: *Bad Year Economics: Cultural Responses to Risk and Uncertainty. Papers presented at Symposium entitled 'Cultural Responses to Risk and Uncertainty' at 1984 TAG, Cambridge*. Ed. P. Halstead and J. O'Shea. Cambridge and New York: Cambridge University Press, pp. 68–80.

- (1995). "From sharing to hoarding: the Neolithic foundations of Aegean Bronze Age society". In: *POLITEIA: Society and State in the Aegean Bronze Age. Proceedings of the 5th International Aegean Conference/5e Rencontre égéenne internationale, University of Heidelberg, Archäologisches Institut, 10–13 April 1994*. Aegaeum 12. Ed. R. Laffineur and W.-D. Niemeier. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 11–21.
- (1999). "Neighbours from hell? The household in Neolithic Greece". In: *Neolithic Society in Greece*. Ed. P. Halstead. Sheffield Studies in Aegean Archaeology. Sheffield: Sheffield Academic Press, pp. 77–95.
- Hamilton, S., M. Seager Thomas and R. Whitehouse (2011). "Say it with stone: constructing with stones on Easter Island". *World Archaeology* 43.2, pp. 167–90.
- Hankey, V. (1967). "Mycenaean pottery in the Middle East: notes on finds since 1951". *Annual of the British School at Athens* 62, pp. 107–47.
- (1970–71). "Mycenaean trade with south-eastern Mediterranean". *Mélanges de l'Université Saint-Joseph* 46, pp. 3–29.
- (1993a). "Pottery as evidence for trade: the Levant from the mouth of the river Orontes to the Egyptian border". In: *Wace and Blegen: Pottery as Evidence for Trade in the Aegean Bronze Age, 1939–1989. Proceedings of the International Conference held at the American School of Classical Studies at Athens, December 2–3, 1989*. Ed. C. W. Zerner, P. C. Zerner and J. Winder. Amsterdam: J. C. Gieben, pp. 101–8.
- (1993b). "Pottery as evidence for trade: Egypt". In: *Wace and Blegen: Pottery as Evidence for Trade in the Aegean Bronze Age, 1939–1989. Proceedings of the International Conference held at the American School of Classical Studies at Athens, December 2–3, 1989*. Ed. C. W. Zerner, P. C. Zerner and J. Winder. Amsterdam: J. C. Gieben, pp. 109–16.
- Hänsel, B. (2007). "Ägäische Siedlungsstrukturen in Monikodonja/Istrien?". In: *Between the Aegean and Baltic Seas: Prehistory Across Borders. Proceedings of the International Conference Bronze and Early Iron Age Interconnections and Contemporary Developments between the Aegean and the Regions of the Balkan Peninsula, Central and Northern Europe. University of Zagreb, 11–14 April 2005*. Aegaeum 27. Ed. I. Galanaki, H. Tomas, Y. Galanakis and R. Laffineur. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 149–56.
- Hardesty, D. L. (2003). "Mining rushes and landscape learning in the modern world". In: *Colonization of Unfamiliar Landscapes: The Archaeology of Adaptation*. Ed. M. Rockman and J. Steele. London and New York: Routledge, pp. 81–95.
- Harding, A. (2011). "Evidence for prehistoric salt extraction rediscovered in the Hungarian central mining museum". *The Antiquaries Journal* 91, pp. 27–49.
- Harding, A. and V. Kavruk (2010). "A prehistoric salt production site at Baile Figa, Romania". *Eurasia Antiqua* 16, pp. 131–68.

- Harrell, J. A. (2002). "Pharaonic stone quarries in the Egyptian deserts". In: *Egypt and Nubia: Gifts of the Desert*. Ed. R. Friedman. London: British Museum Press, pp. 232–43.
- Harrell, J. A. and T. M. Bown (1995). "An Old Kingdom basalt quarry at Widan el-Faras and the Quarry Road to lake Moeris in the Faiyum". *Journal of the American Research Center in Egypt* 32, pp. 71–91.
- Harrell, J. A. and V. M. Brown (1994). "Chephren's quarry in the Nubian desert of Egypt". *Nubica* 3.1, pp. 43–57.
- Harrison, T. P., ed. (2008). *Cyprus, the Sea Peoples and the Eastern Mediterranean: Regional Perspectives of Continuity and Change*. Special issue of *Scripta Mediterranea* 27–8 (2006–7). Toronto: Canadian Institute for Mediterranean Studies.
- Haskell, H., R. E. Jones, P. M. Day and J. T. Killen (2011). *Transport Stirrup Jars of the Bronze Age Aegean and East Mediterranean*. Prehistory Monographs 33. Philadelphia: INSTAP Academic Press.
- Hauser, M. W. (2011). "Routes and roots of empire: pots, power, and slavery in the 18th century British Caribbean". *American Anthropologist* 113.3, pp. 431–47.
- Hegmon, M. (1992). "Archaeological research on style". *Annual Reviews of Anthropology* 21, pp. 517–36.
- Heldal, T. (2009). "Constructing a quarry landscape from empirical data: general perspectives and a case study at the Aswan West Bank, Egypt". In: *QuarryScapes: Ancient Stone Quarry Landscapes in the Eastern Mediterranean*. Ed. N. Abu-Jaber, E. G. Bloxam, P. Degryse and T. Heldal. Geological Survey of Norway Special Publication 12. Trondheim: NGU Geological Survey of Norway, pp. 125–53.
- Heldal, T. and P. Storemyr (2007). "The quarries at the Aswan West Bank". In: *Characterisation of Complex Quarry Landscapes: An Example from the West Bank Quarries, Aswan*. Ed. E. Bloxam, T. Heldal and P. Storemyr. QuarryScapes report. Trondheim: Geological Survey of Norway, pp. 69–140. (www.quarryscapes.no).
- Heldal, T., E. Bloxam, P. Storemyr and A. Kelany (2005). "The geology and archaeology of the ancient silicified sandstone quarries at Gebel Gulab and Gebel Tingar, Aswan, Egypt". *Marmora: International Journal for Archaeology, History and Archaeometry of Marbles and Stones* 1, pp. 11–35.
- Heldal, T., E. Bloxam, P. Degryse, P. Storemyr and A. Kelany (2009). "Gypsum quarries in the Northern Faiyum Quarry landscape, Egypt: a geo-archaeological case study". In: *QuarryScapes: Ancient Stone Quarry Landscapes in the Eastern Mediterranean*. Ed. N. Abu-Jaber, E. G. Bloxam, P. Degryse and T. Heldal. Geological Survey of Norway Special Publication 12. Trondheim: NGU Geological Survey of Norway, pp. 51–66.
- Helms, M. W. (1988). *Ulysses' Sail: An Ethnographic Odyssey of Power, Knowledge, and Geographical Distance*. Princeton: Princeton University Press.
- (1993). *Craft and the Kingly Ideal: Art, Trade, and Power*. Austin, TX: University of Texas Press.

- Henderson, J., J. Evans, and K. Nikita (2010). "Isotopic evidence for the primary production, provenance and trade of Late Bronze Age glass in the Mediterranean". *Mediterranean Archaeology and Archaeometry* 10.1, pp. 1–24.
- Herbich, I. and M. Dietler (2008). "The long arm of the mother-in-law: learning, postmarital resocialization of women, and material culture style". In: *Cultural Transmission and Material Culture: Breaking Down Boundaries*. Ed. M. T. Stark, B. J. Bowser and L. Horne. Tucson, AZ: University of Arizona Press, pp. 223–44.
- Herzog, H. A., R. A. Bentley and M. W. Hahn (2004). "Random drift and large shifts in popularity of dog breeds". *Proceedings of the Royal Society Biological Sciences* 271, pp. 1443–50.
- Hilditch, J. (2009). *Reconstruction of Technological Choice, Social Practice and Networks of Exchange from a Ceramic Perspective in the Middle Bronze Age Cyclades*. PhD Thesis. University of Exeter.
- Hobsbawn, E. J. (1951). "The tramping artisan". *Economic History Review* 3.3, pp. 299–320.
- Hodder, I. (1982). *Symbols in Action: Ethnoarchaeological Studies of Material Culture*. New Studies in Archaeology. Cambridge and New York: Cambridge University Press.
- Holst, M. K., M. Rasmussen, K. Kristiansen and J.-H. Bech (2013). "Bronze Age 'Herostrats': ritual, political and domestic economies in Early Bronze Age Denmark". *Proceedings of the Prehistoric Society* 79, pp. 265–96.
- Hood, M. S. F. (1987). "Mason's marks in the palaces". In: *The Functions of the Minoan Palaces: Proceedings of the Fourth International Symposium at the Swedish Institute in Athens, 10–16 June, 1984*. Ed. R. Hägg and N. Marinatos. Skrifter utgivna av Svenska institutet i Athen, 4o Acta Instituti Atheniensis Regni Sueciae 35. Stockholm/Göteborg: Swedish Institute in Athens, pp. 205–12.
- Hope Simpson, R. and D. K. Hagel (2006). *Mycenaean Fortifications, Highways, Dams and Canals*. Studies in Mediterranean Archaeology 133. Sävedalen, Sweden: Paul Åströms Förlag.
- Hopkins, K. (1980). "Taxes and trade in the Roman empire (200 BC–AD 400)". *Journal of Roman Studies* 70, pp. 101–25.
- Horden, P. and N. Purcell (2000). *The Corrupting Sea: A Study of Mediterranean History*. Oxford and Malden, MA: Blackwell.
- (2006). "The Mediterranean and the 'New Thalassology'". *American Historical Review* 111, pp. 722–40.
- Horejs, B. (2007). *Das Prähistorische Olynth: Ausgrabungen in der Toumba Agios Mamas 1994–1996. Die spätbronzezeitliche handgemachte Keramik der Schichten 13 bis 1*. Prähistorische Archäologie in Südosteuropa 21. Rahden/Westf.: Verlag Marie Leidorf.
- Hruby, J. (2007). "Appendix C: the fingerprints on pottery". In: *Midea: The Megaron Complex and Shrine Area*. Ed. G. Walberg. Philadelphia, PA: INSTAP Academic Press, pp. 481–2.

- (2011). "Ke-ra-me-u or Ke-ra-me-ja? Evidence for sex, age and division of labour among Mycenaean ceramicists". In: *Tracing Prehistoric Social Networks through Technology: A Diachronic Perspective on the Aegean*. Ed. A. Brysbaert. London and New York: Routledge, pp. 89–105.
- Hublin, J. -J. (2000). "Modern–nonmodern hominid interactions: a Mediterranean perspective". In: *The Geography of Neandertals and Modern Humans in Europe and the Greater Mediterranean*. Ed. O. Bar-Yosef and D. Pilbeam. Peabody Museum Bulletin 8. Cambridge, MA: Peabody Museum of Archaeology and Ethnology Harvard University, pp. 157–82.
- Hughes-Brock, H. (2005). "Amber and some other travellers in the Bronze Age Aegean and Europe". In: *Authocthon: Papers Presented to O. T. P. K. Dickinson on the Occasion of his Retirement*. Ed. A. Dakouri-Hild and S. Sherratt. British Archaeological Reports International Series 1432. Oxford: Archaeopress, pp. 301–13.
- (2011). "Exotic materials and objects sent to – and from? – the Bronze Age Aegean: some recent work and some observations". In: *Exotica in the Prehistoric Mediterranean*. Ed. A. Vianello. Oxford: Oxbow Books, pp. 99–114.
- Iacono, F. (2012). "Westernizing Aegean of LHIII C". In: *Exchange Networks and Local Transformations: Interaction and Local Change in Europe and the Mediterranean from the Bronze Age to the Iron Age*. Ed. M. E. Alberti, and S. Sabatini. Oxford and Oakville, CT: Oxbow Books, pp. 60–79.
- (2013). *Opening the Sea Gates of Europe: Interaction in the Southern Adriatic Sea during the Late Bronze Age*. PhD Thesis. University College London.
- Ifantidis, F. (2008). "Lithinoi daktylioi apo to Dispilio". *Anaskamma* 1, pp. 79–92.
- (2011). "Cosmos in fragments: *Spondylus* and *Glycymeris* adornments at Neolithic Dispilio". In: *Spondylus in Prehistory: New Data and Approaches. Contributions to the Archaeology of Shell Technologies*. Ed. F. Ifantidis and M. Nikolaidou. British Archaeological Reports International Series 2216. Oxford: Archaeopress, pp. 123–37.
- Ifantidis, F. and P. Papageorgiou (2011). "Sur un anneau néolithique en marbre fragmenté (Dispilio, Grèce)". In: *Profils d'objets: Approches d'anthropologues et d'Archéologues. VIIe Colloque Annuel de la Maison René-Ginouvès, Archéologie et Ethnologie*. Ed. F. Wateau, C. Perlès and Ph. Soulier. Colloques de la Maison René – Ginouvès 7. Paris: De Boccard, pp. 33–43.
- Iles, L. and M. Martínón-Torres (2009). "Pastoralist iron production on the Laikipia Plateau, Kenya: wider implications for archaeometallurgical studies". *Journal of Archaeological Science* 36, pp. 2314–26.
- Irish, J. D. (2006). "Who were the ancient Egyptians? Dental affinities among Neolithic through Postdynastic peoples". *American Journal of Physical Anthropology* 129, pp. 529–43.
- Jackson, C. M. (2005). "Glassmaking in Bronze Age Egypt". *Science* 308, p. 1750–1752.
- Jackson, C. M. and P. T. Nicholson (2010). "The provenance of some ingots from the Uluburun shipwreck". *Journal of Archaeological Science* 37.2, pp. 295–301.

- Janković, S. and W. E. Petraschek (1987). "Tectonics and metallogeny of the Alpine Himalayan Belt in the Mediterranean area and western Asia". *Episodes* 10, pp. 169–75.
- Jansen, A. G. (2002). *A Study of the Remains of Mycenaean Roads and Stations of Bronze-Age Greece*. Mellen Studies in Archaeology 1. Lewiston, NY: Edwin Mellen Press.
- Jennings, J. (2011). *Globalizations and the Ancient World*. Cambridge: Cambridge University Press.
- Jockenhövel, A. (1991). "Räumliche Mobilität von Personen in der mittleren Bronzezeit des westlichen Mitteleuropa". *Germania* 69, pp. 49–62.
- Johns, C. H. W. (1904). *Babylonian and Assyrian Laws, Letters and Contracts*. New York: Scribner & Sons.
- Jones, R. E. (1986). *Greek and Cypriot Pottery: A Review of Scientific Studies*. Fitch Laboratory Occasional Paper 1. Athens: British School at Athens.
- (2005). "Technical studies of Aegean Bronze Age wall painting: methods, results and future prospects". In: *Aegean Wall Painting: A Tribute to Mark Cameron*. Ed. L. Morgan. British School at Athens Studies 13. London: British School at Athens, pp. 199–228.
- Jones, R. E. and C. Mee (1978). "Spectrographic analysis of Mycenaean pottery from Ialysos on Rhodes: results and implications". *Journal of Field Archaeology* 5, pp. 461–70.
- Jones, R. E. and L. Vagnetti (1991). "Traders and craftsmen in the central Mediterranean: archaeological evidence and archaeometric research". In: *Bronze Age Trade in the Mediterranean: Papers Presented at the Conference held at Rewley House, Oxford, December 1989*. Ed. N. H. Gale. Jonsered: Paul Åströms Förlag, pp. 127–47.
- Jones, R. E., S. T. Levi and L. Vagnetti (2002a). "Connections between the Aegean and Italy in the later Bronze Age: the ceramic evidence". In: *Modern Trends in Scientific Studies on Ancient Ceramics*. Ed. V. Kilikoglou, A. Hein and Y. Maniatis. British Archaeological Reports International Series S1011. Oxford: Archaeopress, pp. 171–84.
- Jones, R. E., L. Vagnetti, S. T. Levi, J. Williams, D. Jenkins and A. De Guio (2002b). "Mycenaean pottery from northern Italy: archaeological and archaeometric studies". *Studi Micenei ed Egeo-Anatolici* 44.2, pp. 221–61.
- Jones, R. E., S. T. Levi and M. Bettelli (2005). "Mycenaean pottery in the central Mediterranean: imports, imitations and derivatives". In: *EMPORIA: Aegeans in the Central and Eastern Mediterranean. Proceedings of the 10th International Aegean Conference/10e Rencontre égéenne internationale, Athens, Italian School of Archaeology, 14–18 April 2004*. Ed. R. Laffineur and E. Greco. Aegaeum 25. Liège and Austin, TX: Université de Liège, Histoire de l'art archéologie de la Grèce antique; University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 539–46.

- Jones, R. E., S. T. Levi, M. Bettelli and L. Vagnetti (2013). *Italo-Mycenaean Pottery: the Archaeological and Archaeometric Dimensions*. Incunabula Graeca 103. Rome: CNR-ICEVO/ISMA.
- Jones, S. (1997). *The Archaeology of Ethnicity: Constructing Identities in the Past and the Present*. London: Routledge.
- Jung, R. (2002). *Kastanas. Ausgrabungen in einem Siedlungshuegel der Bronze- und Eisenzeit Makedoniens 1975–1979: Die Drehscheibenkeramik der Schichten 19 bis II, Teil 1 und 2* Prähistorische Archäologie in Südosteuropa 18. Kiel: Verlag Oetker/Voges.
- (2003). “Late Helladic IIIC at the tombs of Kastanas and Olynthos and the problems of Macedonian Mycenaean pottery”. In: *LH IIIC Chronology and Synchronisms: Proceedings of the International Workshop held at the Austrian Academy of Sciences at Vienna, May 7th and 8th, 2001*. Ed. S. Deger-Jalkotzy and M. Zavadil. Wien: Verlag der Österreichischen Akademie der Wissenschaften, pp. 131–44.
- (2005). “Aspekte des Mykenischen Handels und Produktaustauschs”. In: *Interpretationsraum Bronzezeit: Bernhard Hänsel von seinen Schülern gewidmet*. Ed. B. Horejs, R. Jung, E. Kaiser and B. Teržan. Bonn: R. Habelt, pp. 45–70.
- (2006). *Χρονολογία comparata: Vergleichende Chronologie von Südgriechenland und Süditalien von ca. 1700/1600 bis 1000 v.u.Z. Denkschriften*. Österreichische Akademie der Wissenschaften, Philosophisch-historische Klasse, 348. Veröffentlichungen der Mykenischen Kommission 26. Vienna: Verlag der Österreichischen Akademie der Wissenschaften.
- (2007). “Tell Kazel and the Mycenaean contacts with Amurru (Syria)”. In: *The Synchronisation of Civilizations in the Eastern Mediterranean in the Second Millennium BC*, vol. 3. *Proceedings of the SCIEM 2000–2nd EuroConference, Vienna, 28th of May–1st of June 2003*. Ed. M. Bietak and E. Czerny. Contributions to the Chronology of the Eastern Mediterranean 9. Vienna: Verlag der Österreichischen Akademie der Wissenschaften, pp. 551–70.
- (2009a). “Pirates of the Aegean: Italy – the East Aegean – Cyprus at the end of the second millennium BC”. In: *Cyprus and the East Aegean: Intercultural Contacts from 3000 to 500 BC: An International Symposium held at Pythagoreion, Samos. October 17th–18th 2008*. Ed. V. Karageorghis and O. Kouka. Nicosia: A. G. Leventis Foundation, pp. 72–93.
- (2009b). “I ‘bronzi internazionali’ ed il loro contesto sociale fra Adriatico penisola Balcanicae coste Levantine”. In: *From the Aegean to the Adriatic: Social Organisations, Modes of Exchange and Interaction in Postpalatial Times (12th–11th BC)*. *Atti del Seminario internazionale Udine, 1–2 dicembre 2006*. Ed. E. Borgna and P. Càssola Guida. Studi e ricerche di protostoria mediterranea 8. Rome: Quasar, pp. 129–57.
- (2011a). “Mycenaean vending cups in Syria? Thoughts about the unpainted Mycenaean pottery from Tell Kazel”. In: *Our Cups are Full: Pottery and Society*

- in the Aegean Bronze Age. *Papers Presented to Jeremy Rutter on the Occasion of his 65th Birthday*. Ed. W. Gauss, M. Lindblom, R. Angus, K. Smith and J. Wright. Oxford: Archaeopress, pp. 121–32.
- (2011b). “Innovative cooks and new dishes: Cypriote pottery in the 13th and 12th centuries BC and its historical interpretation”. In: *On Cooking Pots, Drinking Cups, Loomweights and Ethnicity in Bronze Age Cyprus and Neighbouring Regions: An International Archaeological Symposium held in Nicosia, November 6th–7th 2010*. Ed. V. Karageorghis and O. Kouka. Nicosia: A. G. Leventis Foundation, pp. 57–85.
- (2012). “Can we say, what’s behind all those sherds? Ceramic innovations in the Eastern Mediterranean at the end of the second millennium”. In: *Materiality and Social Practice: Transformative Capacities of Intercultural Encounters*. Ed. J. Maran and P. W. Stockhammer. Oxford and Oakville, CT: Oxbow Books, pp. 105–20.
- Jung, R. and M. Mehofer (2005/2006). “A sword of Naue II Type from Ugarit, and the historical significance of Italian-type weaponry in the eastern Mediterranean”. *Aegean Archaeology* 8, pp. 111–35.
- (2013). “Mycenaean Greece and Bronze Age Italy: cooperation, trade or war?”. *Archaeologisches Korrespondenzblatt* 43, pp. 175–93.
- Kaczmarczyk, A. (1986). “The source of cobalt in ancient Egyptian pigments”. In: *Proceedings of the 24th International Archaeometry Symposium*. Ed. J. S. Olin and M. J. Blackman. Washington, DC: Smithsonian Institution Press, pp. 369–76.
- Kaczmarczyk, A. and R. E. M. Hedges (1983). *Ancient Egyptian Faience: An Analytical Survey of Egyptian Faience from Predynastic to Roman Times*. Warminster: Aris & Phillips.
- Kaiser, T. M. (1984). *Vinča Ceramics: Economic and Technological Aspects of Late Neolithic Pottery Production in Southeast Europe*. Ann Arbor, MI: University Microfilms International.
- Kakavogianni, O., K. Douni and F. Nezeri (2008). “Silver metallurgical finds dating from the end of the Final Neolithic period until the Middle Bronze Age in the area of Mesogeia”. In: *Aegean Metallurgy in the Bronze Age: Proceedings of an International Symposium held at the University of Crete, Rethymnon, Greece on November 19–21, 2004*. Ed. I. Tzachili. Athens: Ta Pragmata Publications, pp. 45–57 (in Greek).
- Kakavogianni, O., K. Douni, F. Nezeri, M. Georgakopoulou, and Y. Bassiakos (2006). “Attempted technological approach to silver and lead production during the Final Neolithic and Early Helladic I in Mesogeia”. In: *Ancient Greek Technology: Proceedings of the 2nd International Conference on Ancient Greek Technology*. Athens: Technical Chamber of Greece, pp. 77–83 (in Greek).
- Kakavogiannis, E. (2005). *Metalla Ergasima kai Sygkehoremena: The Organization of Lavreotiki Mineral Resource Exploitation by the Athenian Democracy*

- Αθήνα. Archaeologiko Deltion Publications 90. Athens: Ministry of Culture – Archaeological Receipts Fund (in Greek).
- Kalogirou, A. (1994). Production and Consumption of Pottery in Kitrini Limni, West Macedonia, Greece, 4500 B.C.–3500 B.C. PhD Thesis. Indiana University.
- Kamrin, J. (1999). *The Cosmos of Khnumhotep II at Beni Hasan*. London: Kegan Paul International.
- Kaniewski, D., E. Van Campo, J. Guiot, S. L. Burel, T. Otto and C. Baeteman (2013). “Environmental roots of the Late Bronze Age crisis”. *PLoS ONE* 8.8: e71004. doi:10.1371/journal.pone.0071004.
- Kantor, H. J. (1947). *The Aegean and the Orient in the Second Millennium BC*. New York: Archaeological Institute of America.
- Karageorghis, V. (2000). “Cultural innovations in Cyprus relating to the Sea Peoples”. In: *The Sea Peoples and their World: A Reassessment*. Ed. E. D. Oren. University Museum Monograph 108. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology, pp. 255–79.
- Karali, L. (2004). “Anaskafi Stavroupolis: malakologiko”. In: *Rescue Excavations at Neolithic Settlement of Stavroupoli, Thessaloniki, Part II (1998–2003)*. Ed. D. Grammenos and S. Kotsos. Archaeological Institute of Northern Greece Publications 6. Thessaloniki: Archaeological Institute of Northern Greece, pp. 527–603.
- Karamitrou-Mendesidi, G. (2000). “Aiani 2000: excavation of a Late Bronze Age Cemetery”. *Archaeological Work in Macedonia and Thrace* 14, pp. 591–606 (in Greek).
- Karantzali, E. and M. Ponting (2000). “ICP-AES analysis of some Mycenaean vases from the cemetery at Pylona, Rhodes”. *Annual of the British School at Athens* 95, pp. 219–38.
- Karnava, A. (2008). “Written and stamped records in the Late Bronze Age Cyclades: the sea journeys of an administration”. In: *Horizon: A Colloquium on the Prehistory of the Cyclades*. Ed. N. Brodie, J. Doole, G. Gavalas and C. Renfrew. McDonald Institute Monographs. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, pp. 377–86.
- Kassianidou, V. and A. B. Knapp (2005). “Archaeometallurgy in the Mediterranean: the social context of mining, technology, and trade”. In: *The Archaeology of Mediterranean Prehistory*. Ed. E. Blake and A. B. Knapp. Wiley Blackwell Studies in Global Archaeology 6. Oxford: Wiley Blackwell, pp. 215–51.
- Kašuba, M. (2008). “Die ältesten Fibeln im Nordpontus: Versuch einer Typologie der einfachen Violinbogenfibeln im südlichen Mittel-, Süd- und Südosteuropa”. *Eurasia Antiqua. Zeitschrift für Archäologie Eurasiens* 14, pp. 193–231.
- Kaul, F. (2013). “The Nordic razor and the Mycenaean lifestyle”. *Antiquity* 87, pp. 461–72.
- Kayafa, M., Z. A. Stos-Gale and N. H. Gale (2000). “The circulation of copper in the Early Bronze Age in Mainland Greece: the lead isotope evidence from Lerna, Lithares and Tsoungiza”. In: *Metals Make the World Go Round: The Supply and*

- Circulation of Metals in Bronze Age Europe. Proceedings of a Conference held at the University of Birmingham in June 1997*. Ed. C. F. E. Pare. Oxford: Oxbow Books, pp. 39–55.
- Keane, W. (2005). “The hazards of new clothes: what signs make possible”. In: *The Art of Clothing: A Pacific Experience*. Ed. S. Küchler and G. Were. London: UCL Press, pp. 1–16.
- Kelekna, P. (2009). *The Horse in Human History*. Cambridge and New York: Cambridge University Press.
- Kemenczei, T. (1988). *Die Schwerter in Ungarn I (Griffplatten, Griffangel,- und Griffzungenschwerter)*. Prähistorische Bronzefunde 4.6. Munich: Beck.
- (1991). *Die Schwerter in Ungarn II (Vollgriffschwerter)*. Prähistorische Bronzefunde 4.9. Munich: Beck.
- Kern, A., K. Kowarik, A. W. Rausch and H. Reschreiter, eds. (2009). *Kingdom of Salt: 7000 Years of Hallstatt*. Vienna: Natural History Museum.
- Kessler, D. (1987). “Die Asiatenkarawane von Beni Hassan”. *Studien zur altägyptischen Kultur* 14, pp. 147–65.
- Kilian, K. (1990). “Mycenaean colonization: norm and variety”. In: *Greek Colonists and Native Populations: Proceedings of the First Australian Congress of Classical Archaeology held in honour of Emeritus Professor A. D. Trendall*. Ed. J.-P. Descoeudres. Oxford: Clarendon Press, pp. 448–55.
- Kilikoglou, V., C. Doulas, A. Papagiannopoulou, E. V. Sayre, Y. Maniatis and A. P. Grimanis (1990). “A study of Middle and Late Cycladic pottery from Akrotiri”. In: *Thera and the Aegean World III: Proceedings of the 3rd International Congress, Santorini, Greece, 3–9 September 1989*, vol. 1. Ed. D. A. Hardy, C. G. Doulas, J. A. Sakellarakis and P. M. Warren. London: The Thera Foundation, pp. 441–8.
- Kilikoglou, V., Y. Bassiakos, A. P. Grimanis and K. Souvatzis (1996). “Carpathian obsidian in Macedonia, Greece”. *Journal of Archaeological Science* 23, pp. 343–9.
- Killebrew, A. E. (2000). “Aegean-style Early Philistine pottery in Canaan during the Iron I Age: a stylistic analysis of Mycenaean IIIC:1b pottery and its associated wares”. In: *The Sea Peoples and their World: A Reassessment*. Ed. E. D. Oren. University Museum Monograph 108. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology, pp. 233–53.
- (2008). “The Philistine in context: the transmission and appropriation of Mycenaean-style culture in the east Aegean, southeastern coastal Anatolia, and the Levant”. In: *Cyprus, the Sea Peoples and the Eastern Mediterranean: Regional Perspectives of Continuity and Change*. Ed. T. P. Harrison. Special issue of *Scripta Mediterranea* 27–8 (2006–7). Toronto: Canadian Institute for Mediterranean Studies, pp. 245–66.
- Kiriati, E. (1999). “The study of technology as index of human behaviour: observations on pottery manufacture at LBA Toumba Thessalonikis”. In: *Ancient Macedonia, 6th International Symposium, Thessaloniki 15–19 October 1996*, vol. 1. Institute for Balkan Studies 272. Thessaloniki: Institute for Balkan Studies, pp. 585–97.

- (2000). Ceramic Technology and Production. The Pottery of Late Bronze Age from Toumba Thessaloniki. PhD Thesis. Aristotle University of Thessaloniki (in Greek).
- (2003). "Sherds, fabrics and clay sources: reconstructing the ceramic landscapes of prehistoric Kythera". In: *METRON: Measuring the Aegean Bronze Age. Proceedings of the 9th International Aegean Conference, New Haven, Yale University, 18–21 April 2002*. Ed. K. P. Foster and R. Laffineur. Aegaeum 24. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 123–30.
- (2010). "'Minoanising' pottery traditions in the SW Aegean during the MBA: understanding the social context of technological and consumption practices". In: *Mesohelladika: La Grèce continentale au Bronze Moyen. Actes du colloque international organisé par l'École Française d'Athènes, en collaboration avec The American School of Classical Studies at Athens et The Netherlands Institute in Athens, Athènes, 8–12 Mars 2006*. Ed. A. Philippa-Touchais, G. Touchais, S. Voutsaki and J. Wright. Bulletin de Correspondance Hellénique Supplément 52. Athens: École Française d'Athènes, pp. 683–99.
- (in press). "Ceramic traditions and people in the Neolithic 'Drakaina cave', Kefhalonia, west Greece: an integrated technological and petrological study". In: *Drakaina Cave on Kefhalonia Island, Western Greece: A Place of Social Activity during the Neolithic*. Ed. G. Stratouli. Philadelphia: INSTAP Academic Press.
- Kiriati, E., S. Andreou, S. Dimitriadis, and K. Kotsakis (1997). "Co-existing traditions: handmade and wheelmade pottery in Late Bronze Age central Macedonia". In: *TEXNH: Craftswomen, Craftsmen and Craftsmanship in the Aegean Bronze Age. Proceedings of the 6th International Aegean Conference. Philadelphia Temple University, 18–21 April 1996*. Ed. R. Laffineur and P. P. Betancourt. Aegaeum 16. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 361–7.
- Kiriati, E., M. Georgakopoulou and A. Pentedeka (2011). "Pottery production and importation at Bronze Age Kolonna: the ceramic fabrics and the island's landscape". In: *Pottery Production and Supply at Bronze Age Kolonna, Aegina: An Integrated Archaeological and Scientific Study of a Ceramic Landscape*. Ed. W. Gauss and E. Kiriati. Contributions to the Chronology of the Eastern Mediterranean 7. Ägina – Kolonna. Forschungen und Ergebnisse 5. Vienna: Austrian Academy of Sciences Press, pp. 69–156.
- Kiriati, E. M. Georgakopoulou, C. Broodbank and A. Johnston (2012). "Landscape history through the study and analysis of ceramics and metallurgical finds: the example of the Kythera Island Project". In: *Proceedings of the 5th Symposium of the Hellenic Society for Archaeometry*. Ed. N. Zacharias, M. Georgakopoulou, K. Polikreti, Y. Facorellis and Th. Vakoulis. Athens: Papazisi Publications, pp. 289–304 (in Greek).

- Klein, R. G. (2008). "Out of Africa and the evolution of human behavior". *Evolutionary Anthropology* 17, pp. 267–81.
- Klengel, H. (2000). "The 'crisis years' and the new political system in Early Iron Age Stira: some introductory remarks". In: *Essays on Syria in the Iron Age*. Ed. G. Bunnens. Leuven: Peeters, pp. 21–30.
- Kling, B. (2000). "Mycenaean IIIC:1b and related pottery in Cyprus: comments on the current state of research". In: *The Sea Peoples and their World: A Reassessment*. Ed. E. D. Oren. University Museum Monograph 108. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology, pp. 281–95.
- Knapp, A. B. (1993). "Thalassocracies in Bronze Age eastern Mediterranean trade: making and breaking a myth". *World Archaeology* 24.3, pp. 332–47.
- (2008). *Prehistoric and Protohistoric Cyprus: Identity, Insularity, and Connectivity*. Oxford: Oxford University Press.
- Knapp, A. B. and J. F. Cherry (1994). *Provenience Studies and Bronze Age Cyprus: Production, Exchange and Politico-Economic Change*. Monographs in World Archaeology 21. Madison, WI: Prehistory Press.
- Knappett, C. (2001). "Overseen or overlooked? Ceramic production in a Mycenaean palatial system". In: *Economy and Politics in the Mycenaean Palace States*. Ed. S. Voutsaki and J. Killen. Proceedings of the Cambridge Philological Society Supplement 27. Cambridge: Cambridge Philological Society, pp. 80–95.
- (2005). *Thinking through Material Culture: An Interdisciplinary Perspective*. Philadelphia: University of Pennsylvania Press.
- (2011a). *An Archaeology of Interaction: Network Perspectives on Material Culture and Society*. Oxford: Oxford University Press.
- (2011b). "Networks of objects, meshworks of things". In: *Redrawing Anthropology: Materials, Movements, Lines*. Ed. T. Ingold. Anthropological Studies of Creativity and Perception. Farnham: Ashgate, pp. 45–63.
- Knappett, C., ed. (2013). *Network Analysis in Archaeology: New Approaches to Regional Interaction*. Oxford: Oxford University Press.
- Knappett, C. and I. Nikolakopoulou (2005). "MBA interaction networks: Crete, the Cyclades and the South-East Aegean". In: *EMPORIA: Aegeans in the Central and Eastern Mediterranean. Proceedings of the 10th International Aegean Conference/10e Rencontre égéenne internationale, Athens, Italian School of Archaeology, 14–18 April 2004*. Ed. R. Laffineur and E. Greco. Aegaeum 25. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 175–83.
- (2008). "Colonialism without colonies? A Bronze Age case study from Akrotiri, Thera". *Hesperia* 77, pp. 1–42.
- Knappett, C. and S. van der Leeuw (2014). "A developmental approach to ancient innovation: the potter's wheel in the Bronze Age east Mediterranean". *Pragmatics and Cognition* 22(1), 64–92.

- Knipper, C. and D. Price (2009). "Individuelle Mobilität in der Linearbandkeramik: Strontiumisotopanalysen vom Gräberfeld Stuttgart-Mühlhausen Viesenhäuser Hof". In: *Varia neolithica V. Mobilität, Migration und Kommunikation in Europa während des Neolithikums und der Bronzezeit: Beiträge der Sitzungen der Arbeitsgemeinschaften Neolithikum und Bronzezeit während der Jahrestagung des West- und Süddeutschen Verbandes für Altertumsforschung e. V. in Xanten, 6–8 Juni 2006*. Ed. A. Krenn-Leeb, H.-J. Beier, E. Classen, F. Falkenstein and S. Schwenzer. Beiträge zur Ur- und Frühgeschichte Mitteleuropas 53. Langenweissbach: Beier & Beran, pp. 53–63.
- Knoop, D. and G. P. Jones (1932). "Masons and apprenticeship in medieval England". *Economic History Review* 3.3, pp. 346–66.
- Kopytoff, I. (1986). "The cultural biography of things: commoditization as process". In: *The Social Life of Things: Commodities in Cultural Perspective*. Ed. A. Appadurai. Cambridge: Cambridge University Press, pp. 64–91.
- Korcak, J. (1938). "Deux types fondamentaux de distribution statistique". *Bulletin de l'Institut International de Statistique* 3, pp. 295–9.
- Korres, G. S. (1984). "The relations between Crete and Messenia in the Late Middle Helladic and Early Late Helladic period". In: *The Minoan Thalassocracy: Myth and Reality. Proceedings of the Third International Symposium at the Swedish Institute in Athens, 31 May – 5 June, 1982*. Ed. R. Hägg and N. Marinatos. Skrifter utgivna av Svenska institutet i Athen, 40 Acta Instituti Atheniensis Regni Sueciae 32. Stockholm/Göteborg: Svenska Institutet i Athen, pp. 141–52.
- Kotsakis, K. (1999). "What tells can tell: social space and settlement in the Greek Neolithic". In: *Neolithic Society in Greece*. Ed. P. Halstead. Sheffield Studies in Aegean Archaeology. Sheffield: Sheffield Academic Press, pp. 66–76.
- (2006). "Settlement of discord: Sesklo and the emerging household". In: *Homage to Milutin Garašanin*. Ed. N. Tasić and C. Grozdanov. Beograd: Serbian Academy of Sciences and Arts, Macedonian Academy of Sciences and Arts, pp. 207–20.
- Kotsos, S. (2014). "Settlement and housing during the 6th millennium B.C. in western Thessaloniki and the adjacent Langadas province". In: *Proceedings of the International Conference Hundred Year Research in Prehistoric Macedonia*. Ed. E. Stefani, N. Merousis and A. Dimoula. Thessaloniki: Ekdoseis ZHTH, pp. 315–22.
- Kowarik, K., H. Reschreiter and G. Wurzer (in press). "Modelling the Bronze Age Salt Mines of Hallstatt: agent based modeling, system dynamics and experimental archaeology applied to the Bronze Age saltmines of Hallstatt". In: *History of Mining Activities in the Tyrol and Adjacent Areas: Impact of Environment and Human Societies (SFB HiMAT). Proceedings of the 2nd Mining in European History Conference, 7–10 November, 2012, Innsbruck*. Mining in European History. Innsbruck: SFB HiMAT.
- Kozloff, A. P., B. M. Bryan and L. M. Berman (1992). *Egypt's Dazzling Sun: Amenhotep III and his World*. Cleveland, OH: Cleveland Museum of Art.

- Krause, R. (2006/7). "Mediterrane Einflüsse in der Früh- und Mittelbronzezeit Mitteleuropas-Interaktionsräume und Kulturwandel". *Bericht der Bayrischen Bodendenkmalpflege* 47/48, pp. 53–65.
- Krenn-Leeb, A., H.-J. Beier, E., Classen, F. Falkenstein and S. Schwenzer, eds. (2009). *Varia neolithica V. Mobilität, Migration und Kommunikation in Europa während des Neolithikums und der Bronzezeit: Beiträge der Sitzungen der Arbeitsgemeinschaften Neolithikum und Bronzezeit während der Jahrestagung des West- und Süddeutschen Verbandes für Altertumsforschung e. V. in Xanten, 6–8 Juni 2006*. Beiträge zur Ur- und Frühgeschichte Mitteleuropas 53. Langenweissbach: Beier & Beran.
- Kristiansen, K. (1984). "Krieger und Häuptlinge in der Bronzezeit Dänemarks: Ein Beitrag zur Geschichte des bronzezeitlichen Schwertes". *Jahrbuch des Römisch-Germanischen Zentralmuseums* 31, pp. 187–208.
- (1987). "Centre and periphery in Bronze Age Scandinavia". In: *Centre and Periphery in the Ancient World*. Ed. M. Rowlands, M. T. Larsen and K. Kristiansen. New Directions in Archaeology. Cambridge: Cambridge University Press, pp. 74–85.
- (1998). *Europe before History*. Cambridge: Cambridge University Press.
- (2002). "The tale of the sword: swords and swordfighters in Bronze Age Europe". *Oxford Journal of Archaeology* 21.4, pp. 319–32.
- (2004). "Sea faring voyages and rock art ships". In: *The Dover Boat in Context: Society and Water Transport in Prehistoric Europe*. Ed. P. Clark. Oxford: Oxbow Books, pp. 111–21.
- (2006). "Cosmology, economy and long-term change in the Bronze Age of Northern Europe". In: *Ecology and Economy in Stone Age and Bronze Age Scania*. Skånska spor – arkeologi längs Västkustnanan. Ed. K.-G. Sjögren. Stockholm: Riksantikvarieämbetet, pp. 171–93.
- (2011). "Bridging India and Scandinavia: institutional transmission and elite conquest during the Bronze Age". In: *Interweaving Worlds: Systemic Interaction in Eurasia, 7th to the 1st Millennia BC*. Ed. T. C. Wilkinson, S. Sherratt and J. Bennett. Oxford: Oxbow Books, pp. 243–65.
- Kristiansen, K. and T. B. Larsson (2005). *The Rise of Bronze Age Society: Travels, Transmissions and Transformations*. Cambridge: Cambridge University Press.
- Kuhrt, A. (1998). "The Old Assyrian merchants". In: *Trade, Traders and the Ancient City*. Ed. H. Parkins and C. Smith. London: Routledge, pp. 15–29.
- Kyparissi-Apostolika, N. (2001). *Ta Proistorika Kosmimata tis Thessalias*. Athens: TAPA.
- (2011). "Spondylus objects from Theopetra cave, Greece: imported or local production?". In: *Spondylus in Prehistory: New Data and Approaches. Contributions to the Archaeology of Shell Technologies*. Ed. F. Ifantidis and M. Nikolaidou. British Archaeological Reports International Series 2216. Oxford: Archaeopress, pp. 161–7.
- LaBianca, O. S. and S. A. Scham, eds. (2006). *Connectivity in Antiquity: Globalization as Long-Term Historical Process*. London: Equinox.

- Lackenbacher, S. (1995). "Une correspondance entre l'administration du Pharaon Menephtah et le Roi d'Ougarit". In: *Le Pays d'Ougarit autour de 1200 av. J.-C.: Histoire et Archéologie. Actes du Colloque International, Paris, 28 juin – 1er juillet 1993. Ras Shamra-Ougarit XI*. Ed. M. Yon, M. Sznycer and P. Bordreuil. Paris: Editions Recherche sur les Civilisations, pp. 77–84.
- Lane Fox, R. (2008). *Travelling Heroes in the Epic Age of Homer*. London: Allen Lane.
- Larsen, M. T. (1976). *The Old Assyrian City State and its Colonies*. Mesopotamia, Copenhagen Studies in Assyriology 4. Copenhagen: Akademisk Forlag.
- (1987). "Commercial networks in the ancient Near East". In: *Centre and Periphery in the Ancient World*. Ed. M. Rowlands, M. T. Larsen and K. Kristiansen. New Directions in Archaeology. Cambridge: Cambridge University Press, pp. 47–56.
- (2007). "Individual and family in Old Assyrian society". *Journal of Cuneiform Studies* 59, pp. 93–106.
- Lassen, A. W. (2010). "The trade in wool in Old Assyrian Anatolia". *Jaarbericht 'Ex Oriente Lux'* 42, pp. 159–79.
- Lave, J. (1996). "The practice of learning". In: *Understanding Practice: Perspectives on Activity and Context*. Ed. S. Chaiklin and J. Lave. Cambridge: Cambridge University Press, pp. 3–32.
- (2011). *Apprenticeship in Critical Ethnographic Practice*. Chicago: University of Chicago Press.
- Lave, J. and E. Wenger (1991). *Situated Learning: Legitimate Peripheral Participation*. Cambridge and New York: Cambridge University Press.
- Lechtman, H. (1977). "Style in technology: Some early thoughts". In: *Material Cultures: Styles, Organization, and Dynamics of Technology. 1975 Proceedings of the American Ethnological Society*. Ed. H. Lechtman and R. Merrill. St Paul, MN, and New York: West Publishing Co., pp. 3–20.
- Lehner, M. (1997). *The Complete Pyramids*. London: Thames & Hudson.
- Lemonnier, P. (1986). "The study of material culture today: toward an anthropology of technical systems". *Journal of Anthropological Archaeology* 5, pp. 147–86.
- (1992). *Elements for an Anthropology of Technology*. Ann Arbor, MI: University of Michigan/Museum of Anthropology.
- Lemonnier, P., ed. (1993). *Technological Choices. Transformation in Material Cultures since the Neolithic*. London and New York: Routledge.
- Leonard, A. Jr. (1994). *An Index to the Late Bronze Age Aegean Pottery from Syria-Palestine*. Jonsered: Paul Åströms Förlag.
- Leroi-Gourhan, A. (1971). *Évolution et techniques: L'homme et la matière*, vol. 1. Paris: Albin Michel.
- Levi, S. T. (1999). *Produzione e circolazione della ceramica nella Sibaritide Protostorica*, vol. 1. *Impasto e Dolii*. Prima di Sibari 1. Grandi contesti e problemi della Protostoria italiana 1.1. Florence: All'Insegna del Giglio.
- Levi, S. T., M. Sonnino and R. E. Jones (2006). "Eppur si muove... Problematiche e risultati delle indagini sulla circolazione della ceramica dell'età del bronzo

- in Italia". In: *Atti della XXXIX Riunione Scientifica: Materie prime e scambi nella Preistoria Italiana. Firenze, 25–27 Novembre 2004*, vol. 3. Ed. D. Cocchi Genick. Atti della XXXIX Riunione Scientifica. Florence: Istituto Italiano di Preistoria e Protostoria, pp. 1093–1111.
- Lilyquist, C. and R. H. Brill (1993). *Studies in Ancient Egyptian Glass*. New York: Metropolitan Museum of Art.
- Linderholm, A. (2008). *Migration in Prehistory. DNA and Stable Isotope Analyses of Swedish Skeletal Material*. Theses and Papers in Scientific Archaeology 10. Stockholm: Stockholm University.
- Ling, J. (2008). *Elevated Rock Art: Towards a Maritime Understanding of Bronze Age Rock Art in Northern Bohuslän, Sweden*. GOTARC Serie B, Gothenburg Archaeological Theses 49. Gothenburg: University of Gothenburg.
- (2012). "War canoes or social units? Human representation in rock art ships". *European Journal of Archaeology* 15.3, pp. 465–85.
- Ling, J., Z. Stos-Gale, L. Grandin, K. Billström, E. Hjärthner-Holdar and P.-O. Persson (2013). "Moving metals II: provenancing Scandinavian Bronze artefacts by lead isotope and elemental analysis". *Journal of Archaeological Science* 41, pp. 106–32.
- Lis, B. (2009). "Handmade and burnished pottery in the eastern Mediterranean at the end of the Bronze Age: towards an explanation for its diversity and geographical distribution". In: *Forces of Transformation: The End of the Bronze Age in the Mediterranean. Proceedings of an International Symposium held at St. John's College, Oxford on the 25–26th March 2006*. Ed. C. Bachhuber and R. G. Roberts. Themes from the Ancient Near East BANEA Publication Series 1. Oxford: Oxbow Books, pp. 152–63.
- Liversage, D. and J. P. Northover (1998). "Prehistoric trade monopolies and bronze supply in northern Europe". In: *L'Atelier du Bronzier en Europe du XX au VIII siècle avant notre ère: Actes du Colloque International Bronze 96, Neuchâtel et Dijon I: Les Analyses de Composition du Métal: Leur apport à l'archéologie de l'Age du Bronze*. Ed. C. Mordant, M. Pernot and V. Rychner. Paris, pp. 137–50.
- Livingstone Smith A. and A. Vander Vecken (2009). "The 'Crossing Border Project': pottery traditions in Katanga (DRC)". *Afrique, Art, Archéologie* 5, pp. 141–8.
- Lo Schiavo, F. (2001). "Late Cypriot bronzework and bronzeworkers in Sardinia, Italy and elsewhere in the West". In: *Italy and Cyprus in Antiquity: 1500–450 B.C. Proceedings of an International Symposium held at the Italian Academy for Advanced Studies in America at Columbia University, November 16–18, 2000*. Ed. L. Bonfante and V. Karageorghis. Nicosia: Costakis and Leto Severis Foundation, pp. 131–52.
- (2003). "Sardinia between east and west: interconnections in the Mediterranean". In: *Ploes ... Sea Routes ... : Interconnections in the Mediterranean, 16th–6th c. BC. Proceedings of the International Symposium held at Rethymnon, Crete, September 29th–October 2nd 2002*. Ed. N. C. Stampolidis and V. Karageorghis. Athens: A. G. Leventis Foundation/University of Crete, pp. 152–61.

- Loader, N. C. (1995). *The Definition of Cyclopean: An Investigation into the Origins of the LHIII Fortifications on Mainland Greece*. PhD Thesis. Durham University.
- Loney, H. L. (2007). "Prehistoric Italian pottery production: motor memory, motor development and technological transfer". *Journal of Mediterranean Archaeology* 20.2, pp. 183–207.
- Macchiarola, I. (1995). "La facies Appenninica". In: *Aspetti culturali della media eta del bronzo nell'Italia centro-meridionale*. Ed. D. Cocchi Genick. Florence: Franco Cantini, pp. 441–63.
- Macdonald, C. F., E. Hallager, and W.-D. Niemeier, eds. (2009). *The Minoans in the Central, Eastern and Northern Aegean – New Evidence*. Acts of a Minoan Seminar 22–23 January 2005 in Collaboration with the Danish Institute at Athens and the German Archaeological Institute at Athens. Monographs of the Danish Institute at Athens 8. Athens: Danish Institute at Athens.
- MacEachern, S. (1998). "Scale, style, and cultural variation: technological traditions in the northern Mandara mountains". In: *The Archaeology of Social Boundaries*. Ed. M. Stark. Smithsonian Series in Archaeological Inquiry. Washington, DC: Smithsonian Institution Press, pp. 107–31.
- MacGillivray, J. A., L. H. Sackett, D. Smyth, J. Driessen, D. G. Lyness, B. A. Hobbs and A. A. D. Peatfield (1984). "An archaeological survey of the Roussolakkos area at Palaikastro". *Annual of the British School at Athens* 79, pp. 129–59.
- Mahias, M.-C. (1993). "Pottery technique in India: technical variants and social choice". In: *Technological Choices: Transformation in Material Cultures since the Neolithic*. Ed. P. Lemonnier. London and New York: Routledge, pp. 157–80.
- Malinowski, B. (1932). *Argonauts of the Western Pacific. An Account of Native Enterprise and Adventure in the Archipelagoes of Melanesian New Guinea*. London: Routledge.
- Malkin, I. (2003). "Mediterranean paradigms and classical antiquity". *Mediterranean Historical Review*, special issue 18.
- (2011). *A Small Greek World: Networks in the Ancient Mediterranean*. Oxford: Oxford University Press.
- Mallory-Greenough L. M., J. D. Greenough and J. V. Owen (1999). "The stone sources of Predynastic basalt vessels: mineralogical evidence for quarries in northern Egypt". *Journal of Archaeological Science* 26, pp. 1261–72.
- Maner, C. (2012). "A comparative study of Hittite and Mycenaean fortification architecture". In: *ATHANASIA: The Earthly, the Celestial and the Underworld in the Mediterranean from the Late Bronze Age and the Early Iron Age. International Archaeological Conference, Rhodes, 28–31 May, 2009*. Ed. N. C. Stampolidis, A. Kanta and A. Giannikouri Herakleion: University of Crete, pp. 53–64.
- Maniatis, I., S. Papadopoulos, E. Dotsika, E. Kavoussanaki and E. Tzavidopoulos (2009). "Provenance investigation of Neolithic marble vases from Limenaria, Thassos: imported marble to Thassos?". In: *ASMOSIA VII: Proceedings of the 7th International Conference of Association for the Study of Marble and Other*

- Stones in Antiquity, Thassos, September 15–20, 2003*. Ed. I. Maniatis. Bulletin de Correspondance Hellénique Supplement 51. Athens: École française d'Athènes, pp. 439–49.
- Manning, S. W. and L. Hulin (2005). "Maritime commerce and geographies of mobility in Late Bronze Age of the East Mediterranean: problematizations". In: *The Archaeology of Mediterranean Prehistory*. Blackwell Studies in Global Archaeology 6. Ed. E. Blake and A. B. Knapp. Oxford: Blackwell Publishing Ltd, pp. 270–302.
- Maran, J. (2004a). "Architektonische Innovation im spätmykenischen Tiryns: Lokale Bauprogramme und fremde Kultureinflüsse". In: *Althellenische Technologie und Technik: Tagung Ohlstadt 21.-23.03.2003*. Weilheim: Verein zur Förderung der Aufarbeitung der Hellenischen Geschichte, pp. 261–95.
- (2004b). "Wessex und Mykene: Zur Deutung des Bernsteins in der Schachtgräberzeit Süd griechenlands". In: *Zwischen Karpaten und Ägäis. Neolithikum und ältere Bronzezeit. Gedenkschrift für Viera Némecová-Pavúková*. Ed. B. Hänsel and E. Studenikova. Internationale Archäologie. Studia honoraria 21. Rahden/Westf: Verlag Marie Leidorf, pp. 47–65.
- (2007). "Seaborne Contacts between the Aegean, the Balkans and the Central Mediterranean in the 3rd Millennium BC: The Unfolding of the Mediterranean World". In: *Between the Aegean and Baltic Seas: Prehistory across Borders. Proceedings of the International Conference Bronze and Early Iron Age Interconnections and Contemporary Developments between the Aegean and the Regions of the Balkan Peninsula, Central and Northern Europe*. University of Zagreb, 11–14 April 2005. Aegaeum 27. Ed. I. Galanaki, H. Tomas, Y. Galanakis and R. Laffineur. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 3–21.
- (2009). "The crisis years? Reflections on signs of instability in the last decades of the Mycenaean palaces". *Scienze dell'Antichità Storia Archeologia Antropologia* 15, pp. 241–64.
- Maran, J. and P. W. Stockhammer, eds. (2012). *Materiality and Social Practice: Transformative Capacities and Intercultural Encounters*. Oxford: Oxbow Books.
- Marcus, E. S. (2007). "Amenemhet II and the sea: maritime aspects of the Mit Rahina (Memphis) inscription". *Ägypten und Levant* 17, pp. 137–90.
- Marinatos, S. (1973). *Excavations at Thera VI*. Athens: Archaeological Society at Athens Library Series, No. 180.
- Marinos, G. (1951). "Geologia kai metallogenesi tis nisou Serifou". *Geologikai kai Geophysikai Meletai*. Athens: IGME Publications, pp. 95–127 (in Greek).
- Marketou, T. (2009). "Ialyos and its neighbouring areas in the MBA and LB I periods: a chance for peace". In: *The Minoans in the Central, Eastern and Northern Aegean: New Evidence. Acts of a Minoan Seminar 22–23 January 2005 in Collaboration with the Danish Institute at Athens and the German*

- Archaeological Institute at Athens*. Ed. C. F. MacDonald, E. Hallager and W.-D. Niemeier. Monographs of the Danish Institute at Athens 8. Athens: Danish Institute at Athens, pp. 73–96.
- Marketou, T., E. Karantzali, H. Mommsen, N. Zacharias, V. Kilikoglou and A. Schwedt (2006). “Pottery wares from the prehistoric settlement at Ialysos (Trianda) in Rhodes”. *Annual of the British School at Athens* 101, pp. 1–55.
- Marshall, F. and L. Weissbrod (2011). “Domestication processes and morphological change: through the lens of the donkey and African pastoralism”. *Current Anthropology* 52(S4), pp. S397–S413.
- Marthari, M. (2000). “The attraction of the pictorial: observations on the relationship of Thera pottery and Thera fresco iconography”. In: *The Wall Paintings of Thera: Proceedings of the First International Symposium, P.M. Nomikos Conference Centre, Thera, 30 August – 4 September 1997*, vol. 2. Ed. S. Sherratt. Athens: Thera Foundation/Petros M. Nomikos, pp. 873–89.
- Mauss, M. (1935). “Les techniques du corps”. *Journal de psychologie* 32, pp. 271–93.
- Mayor, A. (1994). “Durées de vie des céramiques africaines: facteurs responsables et implications archéologiques”. In: *Terre cuite et société: La céramique, document technique, économique, culturel*. Juan-les-Pins: Editions APDCA, pp. 179–98.
- McBryde, I. (1997). “The landscape is a series of stories: grindstones, quarries and exchange in Aboriginal Australia. A Lake Eyre case study”. In: *Siliceous Rocks and Culture*. Ed. A. Ramos-Millán and M. A. Bustillo Revuelta. International Flint Symposium 6. Granada: Editorial Universidad de Granada, pp. 587–607.
- Mederos Martin, A. (1999). “Ex occidente lux: el comercio Micénico en el Mediterraneo central y occidental (1625–1100 AC)”. *Complutum* 10, pp. 229–66.
- (2008). “Carros Micénicos del Heládico Final III en las estelas decoradas del Bronce Final II-IIIa del de la Península Ibérica”. In: *Contacto cultural entre el Mediterráneo y el Atlántico (siglos XII–VIII a.n.e): La precolonización a debate*. Ed. S. Celestino, N. Rafael and X.-L. Armada. Escuela Española de Historia y Arqueología en Roma 11. Madrid: Consejo Superior de Investigaciones Científicas, pp. 437–63.
- (2009). “La crisis del siglo XII a.C. pueblos del mar y guerra de Troya ca. 1215–1175 a.C.”. *SPAL: Revista de Prehistoria y Arqueología de la Universidad de Sevilla* 16 (2007), pp. 93–153.
- (2012). “El origen de las estelas decoradas del suroeste de la península Iberica en el Bronce Final II (1325–1150 a. C.)”. *Anejos de AEA* 62, pp. 418–54.
- Meltzer, D. J. (2003). “Lessons in landscape learning”. In: *Colonization of Unfamiliar Landscapes: The Archaeology of Adaptation*. Ed. M. Rockman and J. Steele. London and New York: Routledge, pp. 222–41.
- Mercuri, A. M., C. A. Accorsi, M. Bandini Mazzanti, G. Bosi, G., A. Cardarelli, D. Labate, M. Marchesini and G. Grandi (2006). “Economy and environment of Bronze Age settlements – Terramaras – on the Po Plain (Northern Italy): first results from the archaeobotanical research at the Terramara di Montale”. *Vegetation History and Archaeobotany* 16.1, pp. 43–60.

- Meskel, L. and R. Joyce (2003). *Embodied Lives: Figuring Ancient Maya and Egyptian Experience*. London: Routledge.
- Mesoudi, A. and S. J. Lycett (2009). "Random copying, frequency-dependent copying and culture change". *Evolution and Human Behaviour* 30.1, pp. 41–8.
- Michel, C. (1992). "Les 'diamants' du roi de Mari". In: *Florilegium Marianum I: Recueil d'études en l'honneur de Michel Fleury*. Ed. J.-M. Durand. Paris: Nouvelles Assyriologiques Brèves et Utilitaires, pp. 127–36.
- Milić, M. (2016). "A question of scale? Connecting communities through obsidian exchange in the Neolithic Aegean, Anatolia and Balkans". In: *Of Odysseys and Oddities: Scales and Modes of Interaction in the Prehistoric Aegean and Southern Balkans*. Ed. B. Molloy. Sheffield Aegean Round Table 2013. Oxford: Oxbow Books, pp. 97–122.
- Mitrevski, D. (2007). "The beginning of the Iron Age in Macedonia". In: *The Struma/Strymon River Valley in Prehistory. Proceedings of the International Symposium Strymon Praehistoricus, Kjustendil-Blagoevgrad (Bulgaria) and Serres-Amphipolis (Greece), 27.09–01.10.2004*. Ed. M. Stefanovich, H. Todorova and G. Ivanov. In the Steps of James Harvey Gaul 2. Sofia: Gerda Henkel Stiftung, pp. 443–51.
- Molloy, B. (2009). "For Gods or men? A reappraisal of the function of European Bronze Age shields". *Antiquity* 83, pp. 1052–64.
- (2010). "Swords and swordsmanship in the Aegean Bronze Age". *American Journal of Archaeology* 114.3, pp. 403–28.
- Momigliano, N. (2012). *Bronze Age Carian Iasos: Structures and Finds from the Area of the Roman Agora (c. 3000–1500 BC)*. Missione Archeologica Italiana di Iasos 4. Roma: G. Bretschneider.
- Mommsen, H. and J. Maran (2000–2001). "Production places of some Mycenaean pictorial vessels – the contribution of chemical pottery analysis". *Opuscula Atheniensia* 25, pp. 95–106.
- Mommsen, H., A. Kreuser, J. Weber and C. Podzuweit (1989). "Classification of Mycenaean pottery from Kastanas by Neutron Activation Analysis". In: *Archaeometry: Proceedings of the 25th International Symposium, Athens, 19–23 May 1986*. Ed. Y. Maniatis. Amsterdam: Elsevier, pp. 515–23.
- Mommsen, H., T. Beier, U. Diehl and C. Podzuweit (1992). "Provenance determination of Mycenaean sherds found in Tell el Amarna by neutron activation analysis". *Journal of Archaeological Science* 19, pp. 295–302.
- Mommsen, H., D. Hertel, and P. A. Mountjoy (2001). "Neutron activation analysis of the pottery from Troy in the Berlin Schliemann collection". *Archaeologischer Anzeiger*, pp. 169–211.
- Mommsen, H., T. Beier, and A. Hein (2002). "A complete chemical grouping of the Berkeley Neutron activation analysis data on Mycenaean pottery". *Journal of Archaeological Science* 29, pp. 613–37.
- Monroe, C. M. (2009). *Scales of Fate: Trade, Tradition, and Transformation in the Eastern Mediterranean, ca. 1350–1175 BCE*. Alter Orient und Altes Testament 357. Münster: Ugarit-Verlag.

- (2011). "From luxuries to anxieties: a liminal view of the Late Bronze Age world-system". In: *Interweaving Worlds: Systemic Interactions in Eurasia 7th to the 1st Millennium BC*. Ed. T. Wilkinson, S. Sherratt and J. Bennett. Oxford: Oxbow Books, pp. 87–99.
- Montgomery, J. and J. A. Evans (2006). "Immigrants on the Isle of Lewis – combining traditional funerary and modern isotope evidence to investigate social differentiation, migration and dietary change in the Outer Hebrides of Scotland". In: *Social Archaeology of Funerary Remains*. Ed. R. Gowland and C. Knüsel. Oxford: Oxbow Books, pp. 122–42.
- Moores, R. G. (1991). "Evidence for use of a stone-cutting drag saw by the fourth dynasty Egyptians". *Journal of the American Research Center in Egypt* 28, pp. 139–48.
- Moorey, P. R. S. (1994). *Ancient Mesopotamian Materials and Industries*. Oxford: Oxford University Press.
- (2001). "The mobility of artisans and opportunities for technology transfer". In: *The Social Context of Technological Change: Egypt and the Near East 1650–1550 BC. Proceedings of a Conference held at St. Edmund Hall, Oxford 12–14 September 2000*. Ed. A. J. Shortland. Oxford: Oxbow Books, pp. 1–14.
- Moosauer, M. and T. Bachmaier (2005). *Bernstorf: Das Geheimnis der Bronzezeit*. Stuttgart: Theiss, Konrad.
- Moran, W. L. (ed. and transl.) (1992). *The Amarna Letters*. Baltimore and London: Johns Hopkins University Press.
- Mordant, C., S. Rottier and L. Saligny (2007). "De la notion mobilité au sein des populations, du Bronze Moyen à l'étape initiale du Bronze Final en France orientale (XV–XIII siècle avant J.-C.)". In: *Environnements et cultures à l'Age du Bronze en Europe Occidentale: Actes du colloque 'Emprises, déprises et rythmes agricoles à l'Age du Bronze', Congrès National des Sociétés Historiques et Scientifiques, Besançon 2004*. Ed. H. Richard, M. Magny and C. Mordant. Actes des Congrès Nationaux des Sociétés Historiques et Scientifiques 129. Documents préhistoriques 21. Paris: CTHS, pp. 143–57.
- Morkot, R. G. (2007). "War and the economy: the international 'arms trade' in the Late Bronze Age and after". In: *Egyptian Stories: A British Egyptological Tribute to Alan B. Lloyd on the Occasion of his Retirement*. Ed. T. Schneider and K. Szpakowska. Alter Orient und Altes Testament 347. Münster: Ugarit-Verlag, pp. 169–95.
- Morris, S. P. (2009/10). "Prehistoric Torone: a Bronze Age emporion in the Northern Aegean. Preliminary report on the Lekythos excavations 1986 and 1998–1990". *Mediterranean Archaeology* 22.23, pp. 1–68.
- Mountjoy, P. A. (1986). *Mycenaean Decorated Pottery: A Guide to Identification*. Studies in Mediterranean Archaeology 73. Göteborg: Paul Åströms Förlag.
- (1993). *Mycenaean Pottery: An Introduction*. Oxford University Committee for Archaeology Monograph 36. Oxford: Oxford University Committee for Archaeology.
- (1995). "Thorikos Mine No.3: the Mycenaean pottery". *Annual of the British School at Athens* 90, pp. 195–227.

- (1999). *Regional Mycenaean Decorated Pottery*. Rahden/Westf: Marie Leidorf.
- Mountjoy, P. A. and H. Mommsen (2001). "Mycenaean pottery from Qantir-Piramesse, Egypt". *Annual of the British School at Athens* 96, pp. 123–55.
- (2006). "Neutron activation analysis of Mycenaean pottery from Troia (1988–2003 excavations)". *Studia Troica* 16, pp. 97–123.
- Muhly, J. D. (2004). "Chrysokamino and the beginnings of metal technology on Crete and in the Aegean". In: *Crete Beyond the Palaces: Proceedings of the Crete 2000 Conference*. Ed. L. P. Day, M. S. Mook and J. D. Muhly. Prehistory Monographs 10. Philadelphia: INSTAP Academic Press, pp. 283–9.
- Mukherjee, A., E. Roßberger, M. A. James, P. Pfälzner, C. L. Higgitt, R. White, D. A. Peggie, D. Azar, and R. P. Evershed (2008). "The Qatna lion: scientific confirmation of Baltic amber in late Bronze Age Syria". *Antiquity* 82, pp. 49–59.
- Müller, N. (2009). *Technology of Bronze Age Cooking Vessels from Akrotiri*. PhD Thesis. University of Sheffield.
- Murray, G. W. (1947). "A note on the Sadd el-Kafara: the ancient dam in the Wadi Garawi". *Bulletin de l'Institut d'Égypte* 28, pp. 33–43.
- Nakassis, D. (2010). "Reevaluating staple and wealth finance at Mycenaean Pylos". In: *Political Economies of the Aegean Bronze Age: Papers from the Langford Conference, Florida State University, Tallahassee, 22–24 February 2007*. Ed. D. Pullen. Oxford and Oakville, CT: Oxbow Books, pp. 127–48.
- Needham, S. (2009). "Encompassing the sea: 'maritories' and Bronze Age maritime interactions". In: *Bronze Age Connections: Cultural Contact in Prehistoric Europe*. Ed. P. Clark. Oxford: Oxbow Books, pp. 12–37.
- Neipert, M. (2006). *Der 'Wanderhandwerker': Archäologisch-ethnographische Untersuchungen*. Tübinger Texte 6. Rahden/Westfalen: Verlag Marie Leidorf.
- Nelson, M. C. (2001). *The Architecture of Epáno Englianos, Greece*. PhD Thesis. University of Toronto.
- (2006). "Pylos, block masonry and monumental architecture in the Late Bronze Age Peloponnese". In: *Power and Architecture: Monumental Public Architecture in the Bronze Age Near East and Aegean*. Ed. J. Bretschneider, J. Driessen and K. Van Lerberghe. *Orientalia Lovaniensia Analecta* 156. Leuven: Peeters, pp. 143–59.
- Newberry, P. E. (1893). *Beni Hasan Part I: Memoirs/Archaeological Survey of Egypt*, vol. 1. London: Kegan Paul, Trench, Trübner & Co.
- Nicholson, P. T. (1993). *Ancient Egyptian Faience and Glass: Shire Egyptology*. London: Shire Publications.
- Nicholson, P. T. and J. Henderson (2000). "Glass". In: *Ancient Egyptian Materials and Technology*. Ed. P. T. Nicholson and I. Shaw. Cambridge: Cambridge University Press, pp. 195–226.
- Nightingale, G. (2002). "Aegean glass and faience beads: an attempted reconstruction of a palatial Mycenaean high-tech industry". In: *Hyalos-Vitrum-Glass: History, Technology and Conservation of Glass and Vitreous Materials in the Hellenic World. 1st International Conference*. Ed. G. Kordas. Athens: Glasnet Publications, pp. 47–54.

- Nikita, K. and J. Henderson (2006). "Glass analyses from Mycenaean Thebes and Elateia: compositional evidence for a Mycenaean glass industry". *Journal of Glass Studies* 48, pp. 71–120.
- Nikolaidou, M. (2010). "Kosmimata sti Neolithiki Makedonia". In: *IRIS. Studies in Memory of Professor Angeliki Pilali-Papasteriou, from her Students at the University of Thessaloniki*. Ed. N. Merousis, E. Stefani and M. Nikolaidou. Thessaloniki: Kornilia Sphakianaki Publications, pp. 137–54.
- Nikolakopoulou, I. (2003). "Akrotiri, Thera: the town in times of emergency". In: *Argonautis': Studies in Honour of Prof. C. Doumas*. Ed. A. Vlachopoulos and K. Birtacha. Athens: Kathimerini Publications, pp. 554–73 (in Greek).
- (2009). "'Beware Cretans bearing gifts': tracing the origins of Minoan influence at Akrotiri, Thera". In: *The Minoans in the Central, Eastern and Northern Aegean – New Evidence: Acts of a Minoan Seminar 22–23 January 2005 in Collaboration with the Danish Institute at Athens and the German Archaeological Institute at Athens*. Ed. C. F. Macdonald, E. Hallager and W.-D. Niemeier. Monographs of the Danish Institute at Athens 8. Athens: Danish Institute at Athens, pp. 31–9.
- (2010). "Middle Cycladic iconography: a new chapter in Aegean art". In: *Cretan Offerings: Studies in Honour of Peter Warren*. Ed. O. Krzyszkowska. British School at Athens Studies 18. London: British School at Athens, pp. 213–22.
- Nolte, B. (1968). *Die Glasgefäße im alten Ägypten*. Berlin: Verlag Bruno Hessling.
- Norwich, J. J. (2006). *The Middle Sea: A History of the Mediterranean*. London: Chatto & Windus.
- Nylander, C. (1972). "Foreign craftsmen in Achaemenian Persia". In: *The Memorial Volume of the Vth International Congress of Iranian Art and Archaeology, 11th–18th April 1968*. Ed. A. Tajvidi and M.-Y. Kiani. Tehran: Ministry of Culture and Arts, pp. 311–18.
- (1974). "Masons' marks in Persepolis: a progress report". In: *Proceedings of the 2nd Annual Symposium on Archaeological Research in Iran 29th October–1st November, 1973, Tehran, 1974*. Ed. F. Bagherzadeh. Tehran: Iranian Centre for Archaeological Research, pp. 216–22.
- O'Brien, M. J. and R. A. Bentley (2011). "Stimulated variation and cascades: two processes in the evolution of complex technological systems". *Journal of Archaeological Method and Theory* 18, pp. 309–35.
- Oka, R. and C. H. Kusimba (2008). "The archaeology of trading systems, part 1: towards a new trade synthesis". *Journal of Archaeological Research* 16, pp. 339–95.
- Olsen, B. (2010). *In Defense of Things: Archaeology and the Ontology of Objects*. Archaeology in Society Series. Lanham, MD: AltaMira press.
- Oren, E. D., ed. (2000). *The Sea Peoples and their World: A Reassessment*. University Museum Monograph 108. Philadelphia: University of Pennsylvania Museum of Archaeology and Anthropology.
- Osborne, R. (1996). "Pots, trade and the Archaic Greek economy". *Antiquity* 70, pp. 31–44.

- Ottaway, B. S. (2001). "Innovation, production and specialization in early prehistoric copper metallurgy". *European Journal of Archaeology* 4, pp. 87–112.
- Ottenjahn, H. (1969). *Die nordischen vollgriffsschweren der älteren und mittleren Bronzezeit*. Berlin: De Gruyter.
- Overbeck, J. C. (1989). *Keos VII. Ayia Irini: Period IV*. Mainz: Philipp von Zabern.
- Palaima, T.G. (1997). "Potter and fuller: the royal craftsmen". In: *TEXNH: Craftswomen, Craftsmen and Craftsmanship in the Aegean Bronze Age. Proceedings of the 6th International Aegean Conference. Philadelphia Temple University, 18–21 April 1996*. Ed. R. Laffineur and P. P. Betancourt. Aegaeum 16. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 407–41.
- Palyvou, C. (2005). *Akrotiri, Thera: An Architecture of Affluence 3,500 Years Old*. Philadelphia: INSTAP Academic Press.
- Panagiotaki, M., L. Papazoglou-Manioudaki, G. Chatzi-Spiliopoulou, E. Andreopoulou-Mangou, Y. Maniatis and A. J. Shortland (2005). "A glass workshop at the Mycenaean citadel of Tiryns in Greece". *Annales du 16e congrès de l'Association Internationale pour l'Histoire du Verre, London, 7–13 September, 2003*. Nottingham: AIHV, pp. 14–19.
- Pantou, P. (in press). "Evidence of prehistoric habitation and metallurgical activities on Seriphos: the site of Plakalona". In: *Prehistoric Metal Production in the Aegean: Material Evidence and Analysis*. Ed. Y. Bassiakos. Heidelberg: Springer Verlag.
- Papadakou, T., D. Urem-Kotsou and K. Kotsakis (in press). "Early Neolithic pottery from Paliambela Kolindrou". *Archaeological Work in Macedonia and Thrace 2012* (in Greek).
- Papadatos, Y. (2007). "The beginning of metallurgy in Crete: new evidence from the FN-EMI settlement at Kephala Petras, Siteia". In: *Metallurgy in the Early Bronze Age Aegean*. Ed. P. M. Day and R. C. P. Doonan. Sheffield Studies in Aegean Archaeology 7. Oxford: Oxbow Books, pp. 154–67.
- Papadimitriou, N. and D. Kriga (2012). "'Peripheries versus core': the integration of secondary states into the world system of the Eastern Mediterranean and the Near East in the Late Bronze Age (1600–1200 BC)". In: *Exchange Networks and Local Transformations. Interaction and Local Change in the Mediterranean from the Bronze Age to the Iron Age*. Ed. M. E. Alberti and S. Sabatini. Oxford: Oxbow Books, pp. 9–21.
- Papadopoulos, J. K. (1997). "Innovations imitations and ceramic style: models of production and modes of dissemination". In: *TEXNH: Craftswomen, Craftsmen and Craftsmanship in the Aegean Bronze Age. Proceedings of the 6th International Aegean Conference. Philadelphia Temple University, 18–21 April 1996*. Ed. R. Laffineur and P. P. Betancourt. Aegaeum 16. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, University of Cambridge, pp. 449–62.

- Papadopoulou, Z. D. (2011). "Akrotiraki and Skali: new evidence for EBA lead/silver and copper production from southern Siphnos". In: *Metallurgy: Understanding How, Learning Why. Studies in Honor of James D. Muhly*. Ed. P. P. Betancourt and S. C. Ferrence. Prehistory Monographs 29. Philadelphia: INSTAP Academic Press, pp. 149–56.
- (2016). "Archaeometallurgical research in southern Siphnos: finds, questions, perspectives". *Proceedings of the 4th Siphnean Symposium*, Siphnos 25–26 June 2010. Ed. G. Zervoudakis. Athens: Society for Siphnean Studies, pp. 29–44 (in Greek).
- Papagiannopoulou, A. (2008). "From pots to pictures: Middle Cycladic figurative arts from Akrotiri, Thera". In: *Horizon: A Colloquium on the Prehistory of the Cyclades*. Ed. N. Brodie, J. Doole, G. Gavalas and C. Renfrew. McDonald Institute Monographs. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, pp. 433–49.
- Pappa, M. (2008). *Organosi tou Chorou kai Oikistika Stoicheia stous Neolithikous Oikismous tis Kentrikis Makedonias: DETH-Thermi-Makriyalos*. PhD Thesis. Aristotle University of Thessaloniki (in Greek).
- Pappa, M., P. Halstead, K. Kotsakis and D. Urem-Kotsou (2004). "Evidence for large-scale feasting at Late Neolithic Makriyalos, N Greece". In: *Food, Cuisine and Society in Prehistoric Greece*. Ed. P. Halstead and J. Barrett. Sheffield Studies in Aegean Archaeology 5. Oxford: Oxbow Books, pp. 16–44.
- Pappa, M. and R. Veropoulidou (2011). "The Neolithic settlement at Makriyalos, Northern Greece: evidence from the *Spondylus gaederopus* artifacts". In: *Spondylus in Prehistory: New Data and Approaches – Contributions to the Archaeology of Shell Technologies*. Ed. F. Ifantidis and M. Nikolaidou. British Archaeological Reports International Series 2216. Oxford: Archaeopress, pp. 105–21.
- Pare, C. F. E. (2000). "Bronze and the Bronze Age". In: *Metals Make the World Go Round: The Supply and Circulation of Metals in Bronze Age Europe. Proceedings of a Conference held at the University of Birmingham in June 1997*. Ed. C. F. E. Pare. Oxford: Oxbow Books, pp. 1–38.
- Parkinson, W. A. and M. L. Galaty, eds. (2009). *Archaic State Interaction. The Eastern Mediterranean in the Bronze Age*. Santa Fe, NM: School for Advanced Research Press.
- Parpola, A. (2005). "The Nasatyas, the chariot and proto-Aryan religion". *Journal of Indological Studies* 16–17, pp. 1–63.
- Payton, R. (1991). "The Ulu Burun writing-board set". *Anatolian Studies* 41, pp. 99–106.
- Pearce, M. (2000). "Metals make the world go round: the copper supply for Frattesina". In: *Metals Make the World Go Round: The Supply and Circulation of Metals in Bronze Age Europe. Proceedings of a Conference held at the University of Birmingham in June 1997*. Ed. C. F. E. Pare. Oxford: Oxbow Books, pp. 108–15.

- Peltenburg, E. J. (1987). "Early faience: recent studies, origins and relations with glass". In: *Early Vitreous Materials*. Ed. M. Bimson and I. C. Freestone. British Museum, Occasional Papers 56. London: British Museum, pp. 5–30.
- Pelton, A., M. G. Stamatakis, E. Kelepertziz and T. Panagou (2015). "Origin and archaeo-metallurgy of a mixed sulphide ore for copper production on the island of Kea, Aegean Sea, Greece". *Archaeometry* 57, pp. 318–43.
- Pentedeke, A. (2009). *Diktya Antallagis tis keramikis kata ti Mesi kai Neoteri Neolithiki sti Thessalia*. PhD Thesis. Aristotle University of Thessaloniki (in Greek).
- (2011). "Links of clay in Neolithic Greece: the case of Platia Magoula Zarkou". In: *Tracing Prehistoric Social Networks through Technology: A Diachronic Perspective on the Aegean*. Ed. A. Brysbaert. Routledge Studies in Archaeology 3. New York and London: Routledge, pp. 106–25.
- Pentedeke, A. and A. Dimoula (2009). "Early pottery technology and the formation of a technological tradition: the case of Theopetra cave, Thessaly, Greece". In: *Interpreting Silent Artefacts: Petrographic Approaches to Archaeological Ceramics*. Ed. P. S. Quinn. Oxford: Archaeopress, pp. 121–38.
- Perdikatsis, V., V. Kilikoglou, S. Sotiropoulou and E. Chryssikopoulou (2000). "Physicochemical characterisation of pigments from Thera wall paintings". In: *The Wall Paintings of Thera: Proceedings of the First International Symposium, P. M. Nomikos Conference Centre, Thera, 30 August–4 September 1997*, vol. 2. Ed. S. Sherratt. Athens: Thera Foundation/Petros M. Nomikos, pp. 103–18.
- Perlès, C. (1987). *Les industries lithiques taillées de Franchthi (Argolide, Grèce)*, vol. 1. *Présentation générale et industries paléolithiques*. Excavations at Franchthi Cave, Greece, 3. Bloomington and Indianapolis: Indiana University Press.
- (1992). "Systems of exchange and organization of production in Neolithic Greece". *Journal of Mediterranean Archaeology* 5.2, pp. 115–64.
- (2001). *The Early Neolithic in Greece*. Cambridge and New York: Cambridge University Press.
- Perlès, C. and K. D. Vitelli (1999). "Craft specialization in the Neolithic of Greece". In: *Neolithic Society in Greece*. Ed. P. Halstead. Sheffield Studies in Aegean Archaeology 2. Sheffield: Sheffield Academic Press, pp. 96–107.
- Petrie, W. M. F. (1883). *The Pyramids and Temples of Gizeh*. London: Field & Tuer, Leadenhall Press.
- Petrie, W. M. F. and E. Mackay (1915). *Heliopolis, Kafr Ammar and Shurafa*. British School of Archaeology in Egypt 24. London: School of Archaeology in Egypt, University College, Quaritch.
- Pfaffenberger, B. (1992). "Social anthropology of technology". *Annual Review of Anthropology* 21, pp. 491–516.
- Philaniotou, O., Y. Bassiakos and M. Georgakopoulou (2011). "Early Bronze Age copper production on Seriphos (Cyclades, Greece)". In: *Metallurgy: Understanding How, Learning Why. Studies in Honour of James D. Muhly*. Ed. P. P. Betancourt and S. C. Ferrence. Prehistory Monographs 29. Philadelphia: INSTAP Academic Press, pp. 157–64.

- Phillips, J. (1992). "Tomb-robbers and their booty in ancient Egypt". In: *Death and Taxes in the Ancient Near East*. Ed. S. E. Orel. Lampeter: Edwin Mellen Press, pp. 157–92.
- Philokyprou, M. (2011). "The initial appearance of ashlar stone in Cyprus: Issues of provenance and use". *Mediterranean Archaeology and Archaeometry* 2, pp. 37–53.
- Pilides, D. (1994). *Handmade Burnished Wares of the Late Bronze Age in Cyprus*. Studies in Mediterranean Archaeology 105. Jonsered: Paul Åströms Förlag.
- Pilides, D. and M.-C. Boileau (2011). "Revisiting the handmade burnished wares of Cyprus: new analytical results". In: *On Cooking Pots, Drinking Pots, Loom Weights and Ethnicity in Bronze Age Cyprus and the Neighbouring Regions: Proceedings of the International Archaeological Symposium, Nicosia, November 6th–7th, 2010*. Ed. V. Karageorghis and O. Kouka. Nicosia: A. G. Leventis Foundation, pp. 113–28.
- Pokutta, D. A. (2013). *Population Dynamics, Diet and Migrations of the Unetice Culture in Poland*. University of Gothenburg, Gotarc Series B 60. Gothenburg: University of Gothenburg.
- Ponikarov, V. (1963). *Geological Map of Syria 1:200.000*. Damascus: Syrian Arab Republic Ministry of Industry.
- Poulaki-Pandermali, E., E. Klinaki, S. Koulidou, E. Papadopoulou and A. Syros (2010). "The Middle and Late Bronze Age in the area of Macedonian Olympos". In: *MESOHELLADIKA: La Grèce continentale au Bronze Moyen. Actes du colloque international organisé par l'École française d'Athènes, en collaboration avec The American School of Classical Studies at Athens et The Netherlands Institute in Athens, Athènes, 8–12 Mars 2006*. Ed. A. Philippa-Touchais, G. Touchais, S. Voutsaki and J. Wright. Bulletin de Correspondance Hellénique Supplement 52. Athens: École française d'Athènes, pp. 987–93 (in Greek).
- Prak, M. (2011). "Mega-structures of the Middle Ages: the construction of religious buildings in Europe and Asia, c.1000–1500". *Journal of Global History* 6, pp. 381–406.
- Preston, L. (2007). "Bringing in the dead: burials and the local perspective on Kythera in the Second Palace period". *Oxford Journal of Archaeology* 26.3, pp. 239–60.
- Price, D., C. Knipper, G. Grupe and V. Smrcka (2004). "Strontium isotopes and prehistoric human migrations: the Bell Beaker period in central Europe". *European Journal of Archaeology* 7.1, pp. 9–40.
- Provenzano, N. (2008). "Les Terramares: entre Europe et Méditerranée". In: *Villes, villages, campagnes de l'Âge du Bronze: Séminaire de Collège de France*. Ed. J. Guilaine. Paris: Editions Errance, pp. 144–58.
- Pryce, T. O., Y. Bassiakos, M. Catapotis and R. C. Doonan (2007). "'De Caerimoniae' technological choices in copper-smelting furnace design at Early Bronze Age Chrysokamino, Crete". *Archaeometry* 49.3, pp. 543–57.

- Pryce, T. O., V. C. Pigott, M. Martín-Torres and Th. Rehren (2010). "Prehistoric copper production and technological reproduction in the Khao Wong Prachan Valley of Central Thailand". *Archaeological and Anthropological Sciences* 2, pp. 237–64.
- Pryor, J. (1988). *Geography, Technology and War: Studies in the Maritime History of the Mediterranean, 649–1571*. Past and Present Publications. Cambridge and New York: Cambridge University Press.
- Pulak, C. (1998). "The Uluburun shipwreck: an overview". *International Journal of Nautical Archaeology* 27.3, pp. 188–224.
- Quirke, S. (2001). *The Cult of Ra: Sun-Worship in Ancient Egypt*. London: Thames & Hudson.
- Radina, F. and G. Recchia, eds. (2010). *Ambra per Agamennone: Indigeni e micenei tra Adriatico, Ionio ed Egeo*. Bari: M. Adda.
- Rahmstorf, L. (2008). "The Bell Beaker phenomenon and the interaction spheres of the Early Bronze Age East Mediterranean: similarities and differences". In: *Construire le temps: Histoire et méthodes des chronologies et calendriers des derniers millénaires avant notre ère en Europe Occidentale. Actes du XXXe Colloque International de Halma-Ipel, UMR 8164 (CNRS, Lille, 3, MCC), 7–9 décembre 2006, Lille*. Ed. A. Lehoërf. Glux-en-Glenne: Bibracte – Centre Archéologique Européen, pp. 149–70.
- (2010a). "Die Nutzung von Booten und Schiffen in der bronzezeitlichen Ägäis und die Fernkontakte der Frühbronzezeit". In: *Der Griff nach den Sternen: Wie Europas Eliten zu Macht und Reichtum kamen. Internationales Symposium in Halle (Saale) 16–21 Februar 2005*. Ed. F. Bertemes and H. Meller. Tagungen des Landesmuseums für Vorgeschichte 5. Halle (Saale): Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt. Landesmuseum für Vorgeschichte, pp. 675–97.
- (2010b). "The concept of weighing during the Bronze Age in the Aegean, the Near East and Europe". In: *The Archaeology of Measurement: Comprehending Heaven, Earth and Time in Ancient Societies*. Ed. I. Morley and C. Renfrew. Cambridge: McDonald Institute Monographs. Cambridge: McDonald Institute for Archaeological Research, University of Cambridge, pp. 88–105.
- Rain, D. (2001). *Eaters of the Dry Season: Circular Labor Migration in the West African Sahel*. Boulder, CO: Westview Press.
- Ramón, G. (2011). "The swallow potters: seasonally migratory styles in the Andes". In: *Archaeological Ceramics: A Review of Current Research*. Ed. S. Scarcella. British Archaeological Reports International Series 2193. Oxford: Archaeopress, pp. 160–75.
- Rehak, P. (1997). "Aegean art before and after the LMIB destructions". In: *TEXNH: Craftsmen, Craftswomen and Craftsmanship in the Aegean Bronze Age. Proceedings of the 6th International Aegean Conference. Philadelphia Temple University, 18–21 April 1996*. Ed. R. Laffineur and P. Betancourt. Aegaeum 16. Liège and Austin, TX: Université de Liège, Histoire de l'art et

- archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 51–67.
- Renfrew, C. (1972). *The Emergence of Civilisation: The Cyclades and the Aegean in the Third Millennium BC*. London: Methuen.
- Renfrew, C., M. Boyd and C. B. Ramsey (2012). “The oldest maritime sanctuary? Dating the sanctuary at Keros and the Cycladic Early Bronze Age”. *Antiquity* 86, pp. 144–60.
- Ricke, H. (1965–9). *Das Sonnenheiligtum des Königs Userkaf*. Wiesbaden: Beiträge zur Ägyptischen Bauforschung und Altertumskunde.
- Robb, J. E. (2007). *The Early Mediterranean Village: Agency, Material Culture, and Social Change in Neolithic Italy*. Cambridge Studies in Archaeology. Cambridge and New York: Cambridge University Press.
- (2013). “Material culture, landscapes of action and emergent causation: a new model for the origins of the European Neolithic”. *Current Anthropology* 54.6, pp. 657–83.
- Roberts, B. W. and M. Vander Linden (2011). *Investigating Archaeological Cultures: Material Culture, Variability, and Transmission*. New York: Springer.
- Rockman, M. (2003). “Knowledge and learning in the archaeology of colonization”. In: *Colonization of Unfamiliar Landscapes: The Archaeology of Adaptation*. Ed. M. Rockman, and J. Steele. London and New York: Routledge, pp. 3–24.
- Rogers, E. (1995). *Diffusion of Innovations* (4th edn). New York: Free Press.
- Rossel, S., F. Marshall, J. Peters, T. Pilgram, M. D. Adams and D. O’Connor (2008). “Domestication of the donkey: timing, processes, and indicators”. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* 105.10, pp. 3715–20.
- Roth, A. M. (1991). *Egyptian Phyles in the Old Kingdom: The Evolution of a System of Social Organization*. Studies in Ancient Oriental Civilization 48. Chicago: Oriental Institute of Chicago.
- Roumpou, M., N. Müller, N. S. Kalogeropoulos, P. M. Day, I. Nikolakopoulou and V. Kilikoglou (2013). “An interdisciplinary approach to the study of cooking vessels from Bronze Age Akrotiri, Thera”. In: *Diet, Economy and Society in the Ancient Greek World: Towards a Better Integration of Archaeology and Science. Proceedings of the International Conference held at the Netherlands Institute at Athens on 22–24 March 2010*. Ed. S. Voutsaki and S.-M. Valamoti. Pharos Supplement 1. Leuven: Peeters, pp. 33–46.
- Routledge, B. and K. McGeough (2009). “Just what collapsed? A network perspective on ‘palatial’ and ‘private’ trade at Ugarit”. In: *Forces of Transformation: The End of the Bronze Age in the Mediterranean. Proceedings of an International Symposium held at St. John’s College, University of Oxford, 25–6th March 2006*. Ed. C. Bachhuber and R. G. Roberts. Themes from the Ancient Near East. BANEA publication series 1. Oxford: Oxbow Books, pp. 22–9.
- Roux, V. (1994). “La technique du tournage: définition et reconnaissance par les macrotraces”. In: *Terre cuite et société: La céramique, document technique,*

- économique, culturel. *XIVe Rencontres Internationales d'Archéologie et d'Histoire d'Antibes, 21–23 Octobre 1993*. Juan-les-Pins: Editions APDCA, pp. 45–58.
- (2003). "A dynamic systems approach to technological change: application to the emergence of the potter's wheel in South Levant". *Journal of Archaeological Method and Theory* 10.1, pp. 1–30.
- (2008). "Evolutionary trajectories of technological traits and cultural transmission. a qualitative approach to the emergence and disappearance of the ceramic wheel-fashioning technique in the southern Levant". In: *Cultural Transmission and Material Culture: Breaking Down Boundaries*. Ed. M. T. Stark, B. J. Bowser and L. Horne. Tucson, AZ: University of Arizona Press, pp. 82–104.
- Roux, V. and D. Corbetta (1989). *The Potter's Wheel: Craft Specialisation and Technical Competence*. New Delhi: Oxford and IBH Publishing.
- Roux, V. and M. A. Courty (1998). "Identification of wheel-fashioning methods: technological analysis of 4th–3rd millennium BC oriental ceramics". *Journal of Archaeological Science* 25, pp. 747–63.
- Rowe, A. (1938). "Provisional notes on the OK inscriptions from the diorite quarries". *Annales du Service des Antiquités de l'Egypte* 38, pp. 391–6.
- Rowlands, M. and J. Ling (2013). "Boundaries, flows and connectivities: mobility and stasis in the Bronze Age". In: *Counterpoint: Essays in Archaeology and Heritage Studies in Honour of Professor Kristian Kristiansen*. Ed. S. Bergerbrant and S. Sabatini. British Archaeological Reports International Series 2508. Oxford: Archaeopress, pp. 517–29.
- Ruffell, A. (1997). "Geological evolution of the Mediterranean basin". In: *The Mediterranean: Environment and Society*. Ed. R. King, L. Proudfoot and B. Smith. London and New York: Arnold, pp. 12–29.
- Ruiz-Gálvez Priego, M. (2008). "Writing, counting, self-awareness, experiencing distant worlds: identity processes and freelance trade in the Bronze Age/Iron Age transition". In: *Contacto cultural entre el Mediterráneo y el Atlántico (siglos XII–VIII a.n.e.): La precolonización a debate*. Ed. S. Celestino, N. Rafael and X.-L. Armada. Escuela Española de Historia y Arqueología en Roma 11. Madrid: Consejo Superior de Investigaciones Científicas, pp. 27–40.
- Ruiz-Gálvez Priego, M. and E. Galán (2013). "A meal for the hero: on the origins of roasted meat, spits and the male ideal". In: *Interaccion social y comercio en la entesala del colonialism*. Ed. M. E. Aubet and P. Sureda. Barcelona: Edicions Bellaterra, pp. 43–69.
- Rutter, J. B. (1990). "Some comments on interpreting the dark-surfaced hand-made burnished pottery of the 13th and 12th century B.C. Aegean". *Journal of Mediterranean Archaeology* 3, pp. 29–49.
- Sackett, J. R. (1982). "Approaches to style in lithic archaeology". *Journal of Anthropological Archaeology* 1, pp. 59–112.
- (1990). "Style and ethnicity in archaeology: the case for isochrestism". In: *The Uses of Style in Archaeology*. Ed. M. W. Conkey and C. A. Hastorf. New Directions in Archaeology. Cambridge: Cambridge University Press, pp. 32–43.

- Salzani, L. (2005). *La Necropoli delle Età del Bronzo all'Olmo di Nogara*. Memorie del Museo Civico di Storia Naturale di Verona – 2. Serie Sezione Science dell'Uomo 8. Verona: Museo Civico di Storia Naturale.
- Sanders, N. K. (1978). *The Sea Peoples: Warriors of the Ancient Mediterranean*. London: Thames & Hudson.
- Saridaki, N., K. Kotsakis, D. Urem-Kotsou and A. Chrisostomou (2014). “Apsalos-Grammi: Ta prota apotelesmata tis analysis tis keramikis tis Mesis Neolithikis periodou”. *Archaeological Work in Macedonia and Thrace 2010*, pp. 81–6 (in Greek).
- Sayre, E. V. and R. W. Smith (1974). “Analytical studies in ancient Egyptian glass”. In: *Recent Advances in the Science and Technology of Materials: Proceedings of the 2nd Cairo Solid State Conference, held in Cairo, Egypt, April 21–26, 1973*, vol. 3. Ed. A. Bishay. New York: Plenum Press, pp. 47–70.
- Scheidel, W. (2007). “Demography”. In: *The Cambridge Economic History of the Greco-Roman World*. Ed. W. Scheidel, I. Morris and R. Saller. Cambridge and New York: Cambridge University Press, pp. 38–86.
- Schiffer, M. S. (2011). *Studying Technological Change: A Behavioral Approach*. Salt Lake City, UT: University of Utah Press.
- Schiffer, M. S. and J. M. Skibo (1987). “Theory and experiment in the study of technological change”. *Current Anthropology* 28, pp. 595–622.
- Schon, R. (2014). “Weight sets and the political economy of the Pylian State”. Paper given at the 115th Annual Meeting of the Archaeological Institute of America, Chicago, 3 January.
- Scott, J. C. (1999). *Seeing Like a State: How Certain Schemes to Improve the Human Condition have Failed*. New Haven: Yale University Press.
- (2010). *The Art of Not Being Governed: An Anarchist History of Upland Southeast Asia*. New Haven: Yale University Press.
- Seeher, J. (2005). “Bohren wie die Hethiter: Rekonstruktion von Bohrmaschinen der Spätbronzezeit und Beispiele ihrer Anwendung”. *Istanbulur Mitteilungen* 55, pp. 17–35.
- (2007). “Sägen wie die Hethiter: Rekonstruktion einer Steinschneidetechnik im bronzezeitlichen Bauhandwerk”. *Istanbulur Mitteilungen* 57, pp. 27–42.
- Sethe, K. (1917). “Ein ägyptisches Denkmal des Alten Reichs von der Insel Kythera mit dem Namen des Sonnenheiligums des Königs Userkef”. *Zeitschrift für ägyptische Sprache und Altertumskunde* 53, pp. 55–8.
- Shackleton, N. J. and C. Renfrew (1970). “Neolithic trade routes re-aligned by oxygen isotope analysis”. *Nature* 228, pp. 1062–5.
- Shafei, A. (1960). “Lake Moeris and Lahûn Mi-Wer and Ro-Hûn: the Great Nile control project executed by the Ancient Egyptians”. *Bulletin Société de Géographie d’Egypte* 33, pp. 187–217.
- Shapiro, B. and M. Hofreiter, eds. (2012). *Ancient DNA: Methods and Protocols*. Methods in Molecular Biology 840. New York: Springer.
- Shaw, I. (2012). *Ancient Egyptian Technology and Innovation*. BCP Egyptology. London: Bloomsbury Academic.

- Shaw, I. E. Bloxam, T. Haldal and P. Storemyr (2010). "Quarrying and landscape at Gebel el-Asr in the Old and Middle Kingdoms". In: *Recent Discoveries and Latest Researches in Egyptology: Proceedings of the First Neapolitan Congress of Egyptology, Naples, June 18th–20th 2008*. Ed. F. Raffaele, M. Nuzzollo and I. Incordino. Wiesbaden: Otto Harrassowitz, pp. 293–312.
- Shaw, J. W. (2009). *Minoan Architecture: Materials and Techniques*. Studi di archeologia cretese 7. Padua: Centro di Archeologia Cretese/Bottega d'Erasmus.
- Shelby, L. R. (1970). "The education of Medieval English master masons". *Medieval Studies* 32, pp. 1–26.
- Sheller, M. and J. Urry (2006). "The new mobilities paradigm". *Environment and Planning A* 38, pp. 207–26.
- Shelmerdine, C. W., ed. (2008). *The Cambridge Companion to the Aegean Bronze Age*. Cambridge: Cambridge University Press.
- Shennan, S. (1993). "Commodities, transactions and growth in the Central European Early Bronze Age". *Journal of European Archaeology* 1.2, pp. 59–72.
- (2002). *Genes, Memes and Human History: Darwinian Archaeology and Cultural Evolution*. London: Thames & Hudson.
- Sherratt, E. S., ed. (2000). *The Wall Paintings of Thera. Proceedings of the First International Symposium, P. M. Nomikos Conference Centre, Thera, 30 August–4 September 1997, vols 1–2*. Athens: Thera Foundation/Petros M. Nomikos.
- Sherratt, E. S. (1999). "E pur si muove: pots markets and values in the second millennium Mediterranean". In: *The Complex Past of Pottery: Production, Circulation and Consumption of Mycenaean and Greek Pottery (Sixteenth to Early Fifth Centuries BC). Proceedings of the ARCHON International Conference, held in Amsterdam, 8–9 November 1996*. Ed. J. P. Crielaard, V. Stissi and G. J. van Wijngaarden. Amsterdam: J. C. Gieben, pp. 163–211.
- (2001). "Potemkin palaces and route-based economies". In: *Economy and Politics in the Mycenaean Palace States*. Ed. S. Voutsaki and J. Killen. Proceedings of the Cambridge Philological Society Supplement 27. Cambridge: Cambridge Philological Society, pp. 214–38.
- (2003a). "Visible writing: questions of script and identity in Early Iron Age Greece and Cyprus". *Oxford Journal of Archaeology* 22, pp. 225–42.
- (2003b). "The Mediterranean economy: 'globalisation' at the end of the second millennium BCE". In: *Symbiosis, Symbolism, and the Power of the Past. Canaan, Ancient Israel, and their Neighbours from the Late Bronze Age through Roman Palaestina. Proceedings of the Centennial Symposium, W. F. Albright Institute of Archaeological Research and American Schools of Oriental Research, Jerusalem, May 29/31, 2000*. Ed. W. G. Dever and S. Gitin. Winona Lake, IN: Eisenbrauns, pp. 37–62.
- (2009). "The Aegean and the wider world: some thoughts on a world-systems perspective". In: *Archaic State Interaction: The Eastern Mediterranean in the Bronze Age*. Ed. W. A. Parkinson and M. L. Galaty. Santa Fe, NM: School for Advanced Research (SAR) Press, pp. 81–107.

- (2010). "Greeks and Phoenicians: perceptions of trade and traders in the early First Millennium BC". In: *Social Archaeologies of Trade and Exchange: Exploring Relationships among People, Places, and Things*. Ed. A. A. Bauer and A. S. Agbe-Davies. Walnut Creek, CA: Left Coast Press, pp. 119–42.
- Sherratt, S. and A. G. Sherratt (1991). "From luxuries to commodities: the nature of Mediterranean Bronze Age trading systems". In: *Bronze Age Trade in the Mediterranean*. Ed. N. H. Gale. Studies in Mediterranean Archaeology 90. Göteborg: Paul Åströms Förlag, pp. 351–86.
- Sherratt, A. G. and E. S. Sherratt (1998). "Small worlds: interaction and identity in the ancient Mediterranean". In: *The Aegean and the Orient in the Second Millennium: Proceedings of the 50th Anniversary Symposium Cincinnati, 18–20 April 1997*. Ed. E. H. Cline and D. Harris-Cline. Aegaeum 18. Liège and Austin, TX: Université de Liège Histoire de l'Art et Archéologie de la Grèce antique. University of Texas at Austin. Program in Aegean Scripts and Prehistory, pp. 329–43.
- (2001). "Technological change in the east Mediterranean Bronze Age: capital, resources and marketing". In: *The Social Context of Technological Change: Egypt and the Near East, 1650–1550 BC. Proceedings of a Conference held at St Edmund Hall, Oxford 12–14 September 2000*. Ed. A. J. Shortland. Oxford: Oxbow Books, pp. 15–38.
- Shortland, A. J. (2012). *Lapis Lazuli from the Kiln: Glass and Glassmaking in the Late Bronze Age*. Studies in Archaeological Sciences 2. Leuven: Leuven University Press.
- Shortland, A. J. and K. Eremin (2006). "The analysis of second millennium glass from Egypt and Mesopotamia, part 1: new WDS analyses". *Archaeometry* 48.4, pp. 581–605.
- Shortland, A. J., P. T. Nicholson and C. M. Jackson (2000). "Lead isotopic analysis of eighteenth dynasty Egyptian eyepaints and lead antimonate colourants". *Archaeometry* 42.1, pp. 153–7.
- Shortland, A. J., N. Rogers and K. Eremin (2007). "Trace element discriminants between Egyptian and Mesopotamian Late Bronze Age glasses". *Journal of Archaeological Science* 34.5, pp. 781–9.
- Shryock, A. and D. Lord Smail (2011). *Deep History: The Architecture of Past and Present*. Berkeley: University of California Press.
- Sicherl, B. (2004). *Studien zur Mittelbronzezeitlichen Bewaffnung in Tschechien, dem Nördlichen Niederösterreich und unter der Südwestlichen Slowakei*. Universitätsforschungen zur Prähistorischen Archäologie 107. Bonn: Habelt.
- Simmons, A. H. et al. (1999). *Faunal Extinctions in an Island Society: Pygmy Hippopotamus Hunters of Cyprus*. New York and London: Kluwer Academic/Plenum.
- Simpson, W. K. (1959). "Historical and lexical notes on the new series of Hammamat inscriptions". *Journal of Near Eastern Studies* 18, pp. 20–37.
- Skourtopoulou, K. (2004). "I lithotechnia apokrousmenou lithou ston oikismo tis Stavroupolis". In: *Rescue Excavations at Neolithic Settlement*

- of *Stavroupoli, Thessaloniki, Part II* (1998–2003). Ed. D. Grammenos and S. Kotsos. Archaeological Institute of Northern Greece Publications 6. Thessaloniki: Archaeological Institute of Northern Greece, pp. 361–476.
- Smith, M. E., ed. (2012). *The Comparative Archaeology of Complex Societies*. Cambridge: Cambridge University Press.
- Soles, J. S. (1983). “A Bronze Age quarry in eastern Crete”. *Journal of Field Archaeology* 10.1, pp. 33–46.
- Sorge, A. and A. P. Roddick (2012). “Mobile humanity: the delocalization of anthropological research”. *Reviews in Anthropology* 41, pp. 273–301.
- Sperber, D. (1996). *Explaining Culture: A Naturalistic Approach*. Oxford: Blackwell.
- Sperber, L. (1999). “Zu den Schwertgräbern im westlichen Kreis der Urnenfelderkultur: profane und religiöse Aspekte”. In: *Eliten in der Bronzezeit: Ergebnisse zweier Kolloquien in Mainz und Athen*. Römisch-Germanisches Zentralmuseum. Forschungsinstitut für Vor- und Frühgeschichte: Monographien 43.1–2. Mainz/Bonn: Römisch-Germanisches Zentralmuseum/Habelt, pp. 605–60.
- Spitaels, P. (1984). “The Early Helladic period in Mine No. 3”. In: *Thorikos VIII 1972/1976*. Ed. H. F. Mussche, J. Bingen, J. Servais and P. Spitaels. Thorikos 8. Gent: Comité des Fouilles Belges en Grèce, pp. 151–74.
- Spivey, N. (1997). *Etruscan Art*. London: Thames & Hudson.
- Spriggs, M. (1997). *The Island Melanesians: The Peoples of South-East Asia and the Pacific*. Oxford and Cambridge: Wiley Blackwell.
- Stanford, D. and B. Bradley (2012). *Across Atlantic Ice: The Origin of America's Clovis Culture*. Berkeley, CA: University of California Press.
- Stark, M. T., ed. (1998). *The Archaeology of Social Boundaries*. Smithsonian Series in Archaeological Inquiry. Washington, DC: Smithsonian Institution Press.
- Starr, R. F. S. (1937). *Nuzi: Report on the Excavation at Yorgan Tepa near Kirkuk, Iraq, Conducted by Harvard University in Conjunction with the American Schools of Oriental 1927–1931*, vol. 2. *Plates and Plans*. Cambridge, MA: Harvard University Press.
- (1939). *Nuzi: Report on the Excavation at Yorgan Tepa near Kirkuk, Iraq, Conducted by Harvard University in Conjunction with the American Schools of Oriental 1927–1931*, vol. 1. *Text*. Cambridge, MA: Harvard University Press.
- Steel, L. (1998). “The social impact of Mycenaean imported pottery in Cyprus”. *Annual of the British School at Athens* 93, pp. 285–96.
- (2002). “Consuming passions: a contextual study of the local consumption of Mycenaean pottery at Tell el-’Ajjū”. *Journal of Mediterranean Archaeology* 15.1, pp. 25–51.
- Stein, D. L. (1989). “A reappraisal of the ‘Saustatar letter’ from Nuzi”. *Zeitschrift für Assyriologie und vorderasiatische Archäologie* 79, pp. 36–60.
- Stein, G. J. (1994). “Introduction part II: the organizational dynamics of complexity in greater Mesopotamia”. In: *Chiefdoms and Early States in the Near East: The Organizational Dynamics of Complexity*. Ed. M. Rothman and G.

- Stein. Monographs in World Archaeology 18. Madison, WI: Prehistory Press, pp. 11–22.
- (2002). “From passive periphery to active agents: emerging perspectives in the archaeology of interregional interaction”. *American Anthropologist* 104.3, pp. 903–16.
- (2008). “A theoretical model for political economy and social identity in the Old Assyrian colonies of Anatolia”. *TÜBA-AR* 11, pp. 25–40.
- Stockhammer, P. W. (2012a). “Conceptualizing cultural hybridization in archaeology”. In: *Conceptualizing Cultural Hybridization: A Transdisciplinary Approach*. Ed. P. W. Stockhammer. Heidelberg: Springer, pp. 43–58
- Stockhammer, P. W., ed. (2012b). *Conceptualizing Cultural Hybridization: A Transdisciplinary Approach*. Heidelberg: Springer.
- Storemyr, P. and T. Heldal (2002). “Soapstone production through Norwegian history: geology, properties, quarrying and use”. In: *ASMOSIA V: Interdisciplinary Studies on Ancient Stone: Proceedings of the Fifth International Conference of the Association for the Study of Marble and Other Stones in Antiquity, June 1998, Boston*. Ed. J. J. Herrman, N. Herz and R. Newman. London: Archetype Publications, pp. 359–69.
- Stos, Z. A. (2009). “Across the wine dark seas ... sailor tinkers and royal cargoes in the Late Bronze Age eastern Mediterranean”. In: *From Mine to Microscope: Advances in the Study of Ancient Technology*. Ed. A. J. Shortland, I. Freestone and T. Rehren. Oxford: Oxbow Books, pp. 163–81.
- Stos-Gale, Z. A. (1989). “Cycladic copper metallurgy”. In: *Old World Archaeometallurgy: Proceedings of the International Symposium ‘Old World Archaeometallurgy’, Heidelberg 1987*. Ed. A. Hauptmann, E. Pernicka and G. A. Wagner. Der Anschnitt 7. Bochum: Deutsches Bergbau-Museum, pp. 279–91.
- (1998). “The role of Kythnos and other Cycladic islands in the origins of Early Minoan metallurgy”. In: *Kea-Kythnos: History and Archaeology. Proceedings of an International Symposium Kea-Kythnos, 22–25 June 1994*. Ed. L. G. Mendoni and A. J. Mazarakis Ainian. Meletemata 27. Athens: KERA-EIE, pp. 717–35.
- (2000). “An overview of lead isotope data for provenance studies and the trade in metals in the Bronze Age Mediterranean”. In: *Metals Make the World Go Round: The Supply and Circulation of Metals in Bronze Age Europe. Proceedings of a Conference held at the University of Birmingham in June 1997*. Ed. C. F. E. Pare. Oxford: Oxbow Books, pp. 56–69.
- (2011). “‘Biscuits with ears’: a search for the origin of the earliest oxhide ingots”. In: *Metallurgy: Understanding How, Learning Why. Studies in Honor of James D. Muhly*. Ed. P. P. Betancourt and S. C. Ferrence. Prehistory Monographs 29. Philadelphia: INSTAP Academic Press, pp. 221–9.
- Stos-Gale, Z. A. and N. H. Gale (2003). “Lead isotopic and other isotopic research in the Aegean”. In: *METRON: Measuring the Aegean Bronze Age. Proceedings of the 9th International Aegean Conference, New Haven, Yale University, 18–21 April 2002*. Ed. K. P. Foster and R. Laffineur. Aegaeum 24. Liège and Austin, TX: Université

- de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 83–101.
- (2006). "Lead isotope and chemical analyses of slags from Chrysokamino". In: *The Chrysokamino Metallurgy Workshop and its Territory*. Ed. P. P. Betancourt. Hesperia Supplement 36. Princeton: American School of Classical Studies at Athens, pp. 299–319.
- Strasser, T. F., E. Panagopoulou, C. N. Runnels, P. M. Murray, N. Thompson, P. Karkanas, F. W. McCoy and K. W. Wegmann (2010). "Stone Age seafaring in the Mediterranean: evidence from the Plakias region for Lower Palaeolithic and Mesolithic habitation of Crete". *Hesperia* 79, pp. 145–90.
- Struve, K. W. (1971). *Die Bronzezeit Periode I–III. Geschichte Schleswig-Holsteins*. Wachholz: Neumunster.
- Taşon, P. S. C. (1991). "The power of stone: symbolic aspects of stone use and tool development in western Arnhem Land, Australia". *Antiquity* 65, pp. 192–207.
- (1994). "Socialising landscapes: the long-term implications of signs, symbols and marks on the land". *Archaeology in Oceania* 29, pp. 117–29.
- Tafuri, M., O. E. Craig and A. Canci (2009). "Stable isotope evidence for the consumption of millet and other plants in Bronze Age Italy". *American Journal of Physical Anthropology* 139, pp. 146–53.
- Tanasi, D. (2009). "Sicily at the end of the Bronze Age: 'Catching the echo'". In: *Forces of Transformation: The End of the Bronze Age in the Mediterranean. Proceedings of an International Symposium held at St. John's College, University of Oxford, 25–26 March 2006*. Ed. C. Bachhuber and R. G. Roberts. Themes from the Ancient Near East BANEA Publication Series 1. Oxford: Oxbow Books, pp. 51–9.
- Tas, I. and M. Özbirecikli (2009). "A review on the tools used for logistics in the Late Bronze Age: the case of the Uluburun shipwreck". *KUBABA-Arkeoloji- Sanat Tarihi – Tarih Dergisi* 13.6, pp. 37–52.
- Televantou, C. (1992). "Theran wall-painting: artistic tendencies and painters". In: *EIKON, Aegean Bronze Age Iconography: Shaping a Methodology. Proceedings of the 4th International Aegean Conference, University of Tasmania, Hobart, Australia, 6–9 April 1992*. Ed. R. Laffineur and J. L. Crowley. Aegaeum 8. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 145–59.
- (2000). "Aegean Bronze Age wall painting: the Thera workshop". In: *The Wall Paintings of Thera: Proceedings of the First International Symposium, P.M. Nomikos Conference Centre, Thera, 30 August – 4 September 1997*, vol. 2. Ed. S. Sherratt. Athens: Thera Foundation/Petros M. Nomikos, pp. 831–43.
- Teržan, B. (2007). "Cultural connections between *Caput Adriae* and the Aegean in the Late Bronze Age and Early Iron Age". In: *Between the Aegean and Baltic Seas: Prehistory across Borders. Proceedings of the International Conference Bronze and Early Iron Age Interconnections and Contemporary Developments*

- between the Aegean and the Regions of the Balkan Peninsula, Central and Northern Europe. University of Zagreb, 11–14 April 2005. Aegaeum 27. Ed. I. Galanaki, H. Tomas, Y. Galanakis and R. Laffineur. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 157–65.
- Theocharis, D. M. (1951). "Excavation at Arafina". *Proceedings of the Athens Archaeological Society*, pp. 77–92. (in Greek).
- (1952). "Excavation at Arafina". *Proceedings of the Athens Archaeological Society*, pp. 129–51. (in Greek).
- Theroux, P. (1995). *The Pillars of Hercules: A Grand Tour of the Mediterranean*. London: Hamish Hamilton.
- Thomas, N. (1991). *Entangled Objects: Exchange, Material Culture, and Colonialism in the Pacific*. Cambridge, MA: Harvard University Press.
- Tomas, H. (2009). "The World beyond the northern margin: the Bronze Age Aegean and the east Adriatic coast". In: *Archaic State Interaction: The Eastern Mediterranean in the Bronze Age*. Ed. W. A. Parkinson and M. L. Galaty. Santa Fe, NM: School for Advanced Research Press, pp. 181–212.
- Trigger, B. G. (1989). *A History of Archaeological Thought*. Cambridge and New York: Cambridge University Press.
- Tringham, R. (2003). "Flaked stone". In: *Prehistoric Sitagroi: Excavations in Northeast Greece, 1968–1970*, vol. 2. *The Final Report*. Ed. E. Elster and C. Renfrew. Monumenta Archaeologica 20. Los Angeles: Cotsen Institute of Archaeology at the University of California, pp. 81–126.
- Tripković, B. and M. Milić (2008). "The origin and exchange of obsidian from Vinca-Belo Brdo". *Starinar* 58, pp. 71–86.
- Tsakanika-Theochari, E. (2006). The Structural Role of Timber in Wall Construction of Palatial Buildings in Minoan Crete. Unpublished PhD Thesis. NTUA Athens (in Greek).
- Tsoraki, C. (2011a) "Disentangling Neolithic networks: ground stone technology, material engagements and networks of action". In: *Tracing Prehistoric Social Networks through Technology: A Diachronic Perspective on the Aegean*. Ed. A. Brysbaert. Routledge Studies in Archaeology 3. London and New York: Routledge, pp. 12–29.
- (2011b). "Stone-working traditions in the prehistoric Aegean: the production and consumption of edge tools at Late Neolithic Makriyalos". In: *Stone Axe Studies III*. Ed. V. Davis and M. Edmonds. Oxford and Oakville, CT: Oxbow Books, pp. 231–44.
- Tsoneki, A. (1989). "The manufacture of Spondylus shell objects at Neolithic Dimini, Greece". *Orient* 25, pp. 1–21.
- Turner, W. E. S. (1956a). "Studies in ancient glasses and glass making processes: part III. The chronology of glass making constituents". *Journal of the Society of Glass Technology* 40, pp. 39–52.

- (1956b). "Studies in ancient glasses and glass making processes: part IV. The chemical composition of ancient glasses". *Journal of the Society of Glass Technology* 40, pp. 162–84.
- Tykot, R. (1996). "Obsidian procurement and distribution in the central and western Mediterranean". *Journal of Mediterranean Archaeology* 9, pp. 39–82.
- Uckelmann, M. (2008). "Irland oder Iberien: Überlegungen zum Ursprung einer Ornamentform der Bronzezeit". In: *Durch die Zeiten: Festschrift für Albrecht Jockenhövel zum 65. Geburtstag*. Ed. F. Verse, B. Knoche, J. Graefe, M. Hohlbein, K. Schierhold, C. Siemann, M. Uckelmann and G. Woltermann. Internationale Archäologie, Studia honoraria, 28. Rahden/Westfalen: Verlag Marie Leidorf, pp. 259–68.
- (2011). "The function of Bronze Age shields". In: *Bronze Age Warfare: Manufacture and Use of Weaponry*. Ed. M. Uckelmann and M. Mödinger. British Archaeological Reports International Series 2255. Oxford: Archaeopress, pp. 187–98.
- Ur, J. (2003). "CORONA satellite photography and ancient road networks: a northern Mesopotamian case study". *Antiquity* 77, pp. 102–15.
- Urem-Kotsou, D. (2006). Neolithiki keramiki tou Makriyalou: diatrofikes sunitheies kai oi koinonikes diastaseis tis keramikis. PhD Thesis. Aristotle University of Thessaloniki (in Greek).
- (2011). "Recent approaches in ceramic research: vessel use and food residue analysis in late Neolithic pottery from northern Greece" (in Croatian with extensive summary in English). In: *Panonski prapovijesni osviti. Zbornik radova posvećenih Korneliji Minichreiter uz 65. Obljetnicu života*. Ed. M. Dizdar and K. Minichreiter. Zagreb: Institut za arheologiju, pp. 247–65.
- Urem-Kotsou, D. and S. Dimitriadis (2002). "Pottery technology". In: *Rescue Excavations at Neolithic Settlement of Stavroupoli, Thessaloniki*. Ed. D. Grammenos and S. Kotsos. Thessaloniki: Eteria Makedonikon Spoudon, pp. 627–82 (in Greek).
- (2004). "I technologia tis keramikis tou neolithikou oikismou tis Stauroupolis: nees paratiriseis kai sumperasmata". In: *Rescue Excavations at Neolithic Settlement of Stavroupoli, Thessaloniki, Part II (1998–2003)*. Ed. D. Grammenos and S. Kotsos. Archaeological Institute of Northern Greece Publications 6. Thessaloniki: Archaeological Institute of Northern Greece, pp. 305–37 (in Greek).
- Urem-Kotsou, D. and K. Kotsakis (2007). "Pottery, cuisine and community in the Neolithic of north Greece". In: *Cooking Up the Past: Food and Culinary Practices in the Neolithic and Bronze Age Aegean*. Ed. Ch. Mee and J. Renard. Oxford and Oakville, CT: Oxbow Books, pp. 225–46.
- (in press). "Cups of conversion: drinking sets in social context in Late Neolithic Northern Greece". In: *Wine Confessions: Production, Trade and Social Significance of Wine in Ancient Greece and Cyprus*. Ed. E. Margaritis, J. Renfrew, and M. Jones. De Gruyter.

- Urem-Kotsou, D., T. Papadakou, A. Papaioannou, N. Saridaki and Z. Intze (2014a). "Pottery and stylistic boundaries: Early and Middle Neolithic pottery in Macedonia". In: *Proceedings of the International Conference Hundred Year Research in Prehistoric Macedonia*. Ed. E. Stefani, N. Merousis and A. Dimoula. Thessaloniki: Ekdoseis ZHTH, pp. 505–17.
- Urem-Kotsou, D., K. Kotsakis, A. Chrisostomou, G. Vouzara, N. Saridaki, T. Papadakou, A. Papaioannou and Ch. Poloukidou (2014b). "First farmers in Almopia: Middle Neolithic settlement at Apsalos". In: *Edessa and its Region: History and Culture*. Ed. A. Chrisostomou and P. Chrisostomou. Edessa: Print Arts, pp. 129–36 (in Greek).
- Urem-Kotsou, D., A. Papaioannou, T. Silva, F. Adaktylou and M. Besios (in press b). "Early and Middle Neolithic settlement at Revenia Korinou: first results of the study of pottery". *Archaeological Work in Macedonia and Thrace 2012* (in Greek).
- Vagnetti, L. (1999). "Mycenaean pottery in the central Mediterranean: imports and local production in their context". In: *The Complex Past of Pottery: Production, Circulation and Consumption of Mycenaean and Greek Pottery (Sixteenth to Early Fifth Centuries BC)*. Ed. J. P. Crielaard, V. Stissi and G. J. van Wijngaarden. Amsterdam: J. C. Gieben, pp. 137–61.
- Vagnetti, L. and R. E. Jones (1988). "Towards the identification of local Mycenaean pottery in Italy". In: *Problems in Greek Prehistory: Papers Presented at the Centenary Conference of the British School at Athens, Manchester, April 1986*. Ed. E. B. French and K. A. Wardle. Bristol: Bristol Classical Press, pp. 335–48.
- Vagnetti, L., R. E. Jones, S. T. Levi, M. Bettelli and L. Alberti (2009). "Ceramiche Egee e di tipo Egeo lungo i versanti Adriatico e Ionico della penisola Italiana: situazioni a confronto". In: *Dall' Egeo all' Adriatico organizzazioni sociali, mondi di scambio e interazione in età postpalaziale (XII–XI sec. a.C.)*. Ed. E. Borgna and P. Càssola Guida. Roma: Quasar, pp. 171–83.
- Valamoti, S. M., M. Mangafa, Ch. Koukouli-Christanthaki and D. Malamidou (2007). "Grape-pressings from northern Greece: the earliest wine in the Aegean?". *Antiquity* 81, pp. 54–61.
- van Dijk, J. (2000). "The Amarna Period and the later New Kingdom". In: *The Oxford History of Ancient Egypt*. Ed. I. Shaw. Oxford: Oxford University Press, pp. 265–307.
- van Dommelen, P. and A. B. Knapp, eds. (2010). *Material Connections in the Ancient Mediterranean: Mobility, Materiality and Identity*. London: Routledge.
- van Wijngaarden, G. J. (2002). *Use and Appreciation of Mycenaean Pottery in the Levant, Cyprus and Italy (1600–1200 BC)*. Amsterdam Archaeological Studies 8. Amsterdam: Amsterdam University Press.
- (2007). "Sharing material culture? Mycenaeans in the Mediterranean". In: *Mediterranean Crossroads*. Ed. S. Antoniadou and A. Pace. Athens: Pierides Foundation, pp. 453–82.

- (2012). "Trade goods reproducing merchants? The materiality of Mediterranean Late Bronze Age exchange". In: *Materiality and Social Practice: Transformative Capacities and Intercultural Encounters*. Ed. J. Maran and P. W. Stockhammer. Oxford and Oakville, CT: Oxbow Books, pp. 61–72.
- Vanschoonwinkel, J. (2006). "Mycenaean expansion". In: *Greek Colonisation: An Account of Greek Colonies and Other Settlements Overseas*, vol. 1. Ed. G. R. Tsatsikis. Mnemosyne Supplementum 193. Leiden and Boston: Brill.
- Vanzetti, A. (2010). "Social structure and power across the Alps in the Early and Middle Bronze Age". In: *Der Griff nach den Sternen: Wie Europas Eliten zu Macht und Reichtum kamen. Internationales Symposium in Halle (Saale) 16–21 Februar 2005*. Ed. H. Meller and F. Bertemes. Tagungen des Landesmuseums für Vorgeschichte Halle 5. Halle (Saale): Landesamt für Denkmalpflege und Archäologie in Sachsen-Anhalt. Landesmuseum für Vorgeschichte, pp. 239–52.
- Ventris, M. and J. Chadwick (1973). *Documents in Mycenaean Greek*. 2nd edn. Cambridge: Cambridge University Press.
- Versluys, M. J. (2014). "Understanding objects in motion: an archaeological dialogue on Romanization". *Archaeological Dialogues* 21.1, pp. 1–20.
- Vianello, A. (2005). *Late Bronze Age Mycenaean and Italic Products in the West Mediterranean: A Social and Economic Analysis*. British Archaeological Reports International Series 1439. Oxford: Archaeopress.
- (2009). "Late Bronze Age exchange networks in the west Mediterranean". In: *Forces of Transformation: The End of the Bronze Age in the Mediterranean. Proceedings of an International Symposium held at St. John's College, University of Oxford, 25th–26th March 2006*. Ed. C. Bachhuber and R. G. Roberts. Themes from the Ancient Near East BANEA Publication Series. 1. Oxford: Oxbow Books, pp. 44–50.
- Vicze, M. (2011). *Bronze Age Cemetery at Dunaujváros Duna-Dülö*. Dissertationes Pannonicae, ex Instituto Archaeologico Universitatis de Rolando Eötvös nominatae Budapestinensis provenientes 4.1. Budapest: Eötvös Loránd University Institute of Archaeological Sciences.
- Videski, Z. (2007). "Mycenaean Influence in the FYRO Macedonia Identified in the Late Bronze Age Cemeteries". In: *Between the Aegean and Baltic Seas: Prehistory across Borders: Proceedings of the International Conference Bronze and Early Iron Age Interconnections and Contemporary Developments between the Aegean and the Regions of the Balkan Peninsula, Central and Northern Europe. University of Zagreb, 11–14 April 2005*. Aegaeum 27. Ed. I. Galanaki, H. Tomas, Y. Galanakis and R. Laffineur. Liège and Austin, TX: Université de Liège, Histoire de l'art et archéologie de la Grèce antique and University of Texas at Austin, Program in Aegean Scripts and Prehistory, pp. 111–14.
- Vigne, J.-D., I. Carrère, F. Briois and J. Guilaine (2011). "The early process of mammal domestication in the Near East: new evidence from the pre-Neolithic and pre-pottery Neolithic in Cyprus". *Current Anthropology* 52.S4, pp. S255–S271.

- Vitale, S. (2016). "Cultural entanglements on Kos during the Late Bronze Age: a comparative analysis of Minoanisation and Mycenaeanisation at the 'Serraglio,' Eleona, and Langada". In: *Beyond Thalassocracies: Understanding Processes of Minoanisation and Mycenaeanisation in the Aegean*. Ed. E. Gorogianni, P. Pavúk and L. Girella. Oxford: Oxbow Books, pp. 75–93.
- Vitelli, K. (1989). "Were pots first made for foods? Doubts from Franchthi". *World Archaeology* 21.1, pp. 17–29.
- Vitelli, K. D. (1994). "Experimental approaches to Thessalian Neolithic ceramics: gray ware and ceramic colour". In: *Thessaly: Fifteen Years of Archaeological Research, 1975–1990*. Athens: Ministry of Culture-Archaeological Receipt Fund, pp. 143–8.
- von Quillfeldt, I. (1995). *Die Vollgriffschwerter in Süddeutschland*. Prähistorische Bronzefunde 4.11. Stuttgart: F. Steiner.
- Voskos, I. and A. B. Knapp (2008). "Cyprus at the end of the Late Bronze Age: crisis and colonization or continuity and hybridization?" *American Journal of Archaeology* 112, pp. 659–84.
- Voutsaki, S. and J. Killen, eds. (2001). *Economy and Politics in the Mycenaean Palace States*. Proceedings of the Cambridge Philological Society Supplement 27. Cambridge: Cambridge Philological Society.
- Voyatzoglou, M. (1974). "The jar makers of Thrapsano in Crete". *Expedition* 16, pp. 18–24.
- Wachsmann, S. (1998). *Seagoing Ships and Seamanship in the Bronze Age Levant*. College Station, TX: Texas A and M University Press; London: Chatham Publishing.
- (2013). *The Gurob Ship-Cart Model and its Mediterranean Context*. College Station, TX: Rachal Foundation Nautical Archaeology Series in Association with the Institute of Nautical Archaeology.
- Wagner, G. A. and G. Weisgerber (1985). *Silber, Blei und Gold auf Sifnos: Prähistorische und Antike Metallproduktion*. Der Anschnitt. Zeitschrift für Kunst und Kultur im Bergbau 3. Bochum: Deutsches Bergbau-Museum.
- Wagner, R. K. and R. J. Sternberg (1985). "Practical intelligence in real-world pursuits: the role of tacit knowledge". *Journal of Personality and Social Psychology* 49.2, pp. 436–58.
- Wahl, J. and T. D. Price (2013). "Local and foreign males in a Late Bronze Age cemetery at Neckarsuhm, southwestern Germany: strontium isotope investigations". *Anthropologischer Anzeiger* 70.3, pp. 289–307.
- Wallaert, H. (2008). "The way of the potter's mother: apprenticeship strategies among Dii potters from Cameroon, west Africa". In: *Cultural Transmission and Material Culture: Breaking Down Boundaries*. Ed. M. T. Stark, B. J. Bowser and L. Horne. Tucson, AZ: University of Arizona Press, pp. 178–98.
- Wallaert-Pêtre, H. (2001). "Learning how to make the right pots: apprenticeship strategies and material culture, a case study in handmade pottery from Cameroon". *Journal of Anthropological Research* 57.4, pp. 471–93.

- Walter, H. and F. Felten (1981). *Alt-Ägina III.1. Die vorgeschichtliche Stadt: Befestigungen, Häuser, Funde*. Mainz am Rhein: Verlag Philipp von Zabern.
- Walton, M. S., A. Shortland, S. Kirk and P. Degryse (2009). "Evidence for the trade of Mesopotamian and Egyptian glass to Mycenaean Greece". *Journal of Archaeological Science* 36, pp. 1496–1503.
- Ward, W. A. and M. S. Joukowsky, eds. (1992). *The Crisis Years: The 12th Century B.C. from Beyond the Danube to the Tigris*. Dubuque, IA: Kendall & Hunt Publications.
- Wardle, K. A. and D. Wardle (2007). "Assiros Toumba: a brief history of the settlement". In: *The Struma/Strymon River Valley in Prehistory: Proceedings of the International Symposium Strymon Praehistoricus, Kjustendil-Blagoevgrad (Bulgaria) and Serres-Amphipolis (Greece), 27.09–01.10.2004*. Ed. M. Stefanovich, H. Todorova and G. Ivanov. In the Steps of James Harvey Gaul 2. Sofia: Gerda Henkel Stiftung, pp. 451–80.
- Warren, P. M. (1969). *Minoan Stone Vases*. Cambridge Classical Studies. Cambridge: Cambridge University Press.
- Weisgerber, G. (2003). "Spatial organisation of mining and smelting in Feinan, Jordan: mining archaeology beyond the history of technology". In: *Mining and Metal Production through the Ages*. Ed. P. T. Craddock and J. Lang. London: British Museum Press, pp. 76–89.
- Wenger, E. (1998). *Communities of Practice: Learning, Meaning and Identity*. Cambridge: Cambridge University Press.
- Westermann, W. L. (1914). "Apprentice contracts and the apprentice system in Roman Egypt". *Classical Philology* 9.3, pp. 295–315.
- Weyl, W. A. (1951). *Coloured Glasses*. Sheffield: Society of Glass Production.
- Whitbread, I. K. (1992). "Petrographic analysis of barbarian ware from the Menelaion, Sparta". In: *Φιλολόκων: Lakonian Studies in Honour of Hector Catling*. Ed. J. M. Sanders. London: British School at Athens, pp. 297–306.
- (1995). *Greek Transport Amphorae: A Petrological and Archaeological Study*. Fitch Laboratory Occasional Paper 4. London: British School at Athens.
- Whitelaw, T. (2001). "Reading between the tablets: accessing Mycenaean palatial involvement in ceramic production and consumption". In: *Economy and Politics in the Mycenaean Palace States*. Ed. S. Voutsaki and J. Killen. Proceedings of the Cambridge Philological Society Supplement 27. Cambridge: Cambridge Philological Society, pp. 51–79.
- (2005). "A tale of three cities: chronology and minoanisation at Phylakopi on Melos". In: *Autochthon: Papers Presented to O. T. P. K. Dickinson on the Occasion of his Retirement, Institute of Classical Studies, University of London, 9 November 2005*. Ed. A. Dakouri-Hild and S. Sherratt. British Archaeological Reports International Series 1432. Oxford: Archaeopress, pp. 37–69.
- (2012). "The urbanisation of prehistoric Crete: settlement perspectives on Minoan state formation". In: *Back to the Beginning: Reassessing Social and Political Complexity on Crete during the Early and Middle Bronze Age*. Ed. I.

- Schoep, P. Tomkins and J. Driessen. Oxford and Oakville, CT: Oxbow Books, pp. 114–76.
- Wiessner, P. (1983). “Style and social information in Kalahari San projectile points”. *American Antiquity* 49, pp. 253–76.
- (1984). “Reconsidering the behavioral basis for style: a case study among the Kalahari San”. *Journal of Anthropological Archaeology* 3, pp. 190–234.
- Wilson, D. E. (1999). *Keos IX. Ayia Irini: Periods I–III. The Neolithic and Early Bronze Age Settlements. Part 1: The Pottery and Small Finds*. Keos results of excavations conducted by the University of Cincinnati under the auspices of the American School of Classical Studies at Athens 9.1. Mainz am Rhein: Verlag Philipp von Zabern.
- Wobst, H. M. (1977). “Stylistic behavior and information exchange”. In: *For the Director: Research Essays in Honor of James B. Griffin*. Ed. C. E. Cleland. Museum of Anthropology (Ann Arbor, MI): Anthropological Papers 61. Ann Arbor, MI: Museum of Anthropology, pp. 317–42.
- Woodward, J. C., ed. (2009). *The Physical Geography of the Mediterranean*. Oxford Regional Environments Series. Oxford and New York: Oxford University Press.
- Woolf, G. (1998). *Becoming Roman: The Origins of Provincial Civilization in Gaul*. Cambridge: Cambridge University Press.
- Wreszinski, W. (1923–40). *Atlas zur altaegyptischen Kulturgeschichte*. Leipzig: J. C. Hinrichs.
- Wright, J. C. (2006). “The formation of the Mycenaean palace”. In: *Ancient Greece: From the Mycenaean Palaces to the Age of Homer*. Ed. S. Deger-Jalkotzy and I. S. Lemos. Edinburgh Leventis Studies 3. Edinburgh: Edinburgh University Press, pp. 7–52.
- (2008). “Early Mycenaean Greece”. In: *The Cambridge Companion to the Aegean Bronze Age*. Ed. C. W. Shelmerdine. Cambridge: Cambridge University Press, pp. 230–57.
- Wright, J. C., ed. (2004). *The Mycenaean Feast*. Hesperia 73.2. Princeton: American School of Classical Studies at Athens.
- Yalcin, Ü., C. Pulak and R. Slotta, eds. (2005). *Das Schiff von Ulu Burun: Welthandel vor 3000 Jahren. Katalog der Ausstellung des Deutschen Bergbau-Museums, Bochum vom 15. Juli 2005 bis 16. Juli 2006*. Veröffentlichungen aus dem Deutschen Bergbau-Museum Bochum 138. Bochum: Deutsches Bergbau-Museum.
- Yasur-Landau, A. (2010). *The Philistines and Aegean Migration at the End of the Late Bronze Age*. New York: Cambridge University Press.
- Yavuz, A. B., M. Bruno and D. Attanasio (2011). “An updated, multi-method database of Ephesos marbles, including white, *Greco Scritto* and *Bigio* varieties”. *Archaeometry* 53, pp. 215–40.
- Yener, A., ed. (2013). *Across the Border: Late Bronze-Iron Age Relationships between Syria and Anatolia. Proceedings of a Symposium held at the Research Center of*

- Anatolian Studies*, Koç University, Istanbul, May 31–June 1, 2010. Ancient Near Eastern Studies Supplement 42. Leuven: Peeters.
- Yiouni, P. (1996). “The Early Neolithic pottery”. In: *Nea Nikomedeia I: The Excavation of an Early Neolithic Village in Northern Greece, 1961–1964*, vol. 1. Ed. R. J. Rodden and K. A. Wardle. British School at Athens Supplement 25. London: British School at Athens, pp. 55–193.
- Younger, J. H. (1987). “The Elgin plaques from the treasury of Atreus: evidence for a new reconstruction of the façade”. In: *Kolloquium zur Ägäischen Vorgeschichte, Mannheim, 20–22.2.1986*. Ed. W. Schiering. Schriften des Deutschen Archäologen-Verbandes 9. Mannheim: Deutscher Archäologen-Verband, pp. 138–50.
- Yoyotte, J. (1975). “Les sementioux et l'exploitation des régions minières à l'ancien Empire”. *Bulletin de la Société française d'Égyptologie* 73, pp. 44–55.
- Zaccagnini, C. (1983). “Patterns of mobility among ancient Near Eastern craftsmen”. *Journal of Near Eastern Studies*, 42.4, pp. 245–64. doi: 10.2307/544537.
- (1987). “Aspects of ceremonial exchange in the Near East during the late second millennium B.C.”. In: *Centre and Periphery in the Ancient World*. Ed. M. Rowlands, M. T. Larsen and K. Kristiansen. New Directions in Archaeology. Cambridge: Cambridge University Press, pp. 57–65.
- Zacharias, N., C. T. Michael, O. Philaniotou-Hadjianastasiou, A. Hein and Y. Bassiakos (2006a). “Fine-grain TL dating of archaeometallurgical furnace walls”. *Journal of Cultural Heritage* 7, pp. 23–9.
- Zacharias, N., C. T. Michael, M. Georgakopoulou, V. Kilikoglou and Y. Bassiakos (2006b). “Quartz TL Dating on selected layers from archaeometallurgical kiln fragments: a proposed procedure to overcome age dispersion”. *Geochronometria* 25, pp. 29–35.
- Zakrzewski, S. (2011). “Population migration, variation and identity: an Islamic population in Iberia”. In: *Social Bioarchaeology*. Ed. S. Agarwal and B. A. Glenross. Blackwell Studies in Global Archaeology 14. Chichester, West Sussex, and Malden MA: Wiley-Blackwell, pp. 183–211.
- Zeebroek, R., J.-M. Decroly, and O. Gosselain (2008). “Casseroles, légumes et Halloween: une approche multiscalaire des phénomènes de diffusion”. In: *Des choses, des gestes, des mots: Repenser les dynamiques culturelles*. Ed. O. Gosselain, R. Zeebroek and J.-M. Decroly. Special edn of *Techniques and Culture* 51, pp. 50–73.
- Zois, A. (1976). *Vasiliki I: New Archaeological Investigation on the Hill near Vasiliki Village at Ierapetra*, vol. 1. Athens: Athens Archaeological Society.
- Zuckerman, S., D., Ben-Shlomo, P. A. Mountjoy, and H. Mommsen (2010). “A provenance study of Mycenaean pottery from northern Israel”. *Journal of Archaeological Science* 37, pp. 409–16.

Index

- acculturation, 103–4, 109, 114n2, 130, 188, 202
- Achaia, 178
- administrative documents, 90
- Adriatic, 19, 40–41, 147, 160, 174
- Aegean, 11, 16, 19, 22, 24, 26–28, 30, 40,
 - 46–48, 58–60, 63–64, 68–69, 85, 90n2,
 - 107, 111, 113–14, 116, 118–19, 121–22,
 - 124–25, 127, 131, 134, 147, 149, 160,
 - 164, 166–67, 173, 175, 177–78, 182–83,
 - 185–86, 191, 195, 204
- east(ern), 135, 137, 150
- north(ern), 43, 135, 151–52
- northwest(ern), 139
- south-central, 49, 64
- south(ern), 16, 46, 49, 51, 56, 58–61, 67,
 - 102, 108–9, 111, 114–15, 140, 144–45,
 - 184–85, 195, 204
- Aegean style pots, 183, 186
- Aegeanisation, 116–19
- Aegeanising, 127
- Aegean-style pottery, 116–17, 121, 123, 126,
 - 149, 188
- Aegean-type vessels, 122
- Aegina, 19, 51n3
- Africa, 3, 12–13, 15, 19, 24–25, 164, 169, 193,
 - 204–5
- agency, 8, 10, 31, 131, 155, 186, 191
- Agios Mamas, 145
- Agios Sostis (Siphnos), 60
- Akkar Plain, 121–22, 125–27
- Akrotiraki (Siphnos), 51n1, 55, 59, 63
- Akrotiri, 15, 89, 103, 107–10, 112–14
- Alashiya, 175
- Amarna, 94, 158
- Amarna letters, 28, 73, 98, 173, 186
- amber, 157, 164–65, 165n1, 170, 172–73,
 - 177–80, 183
- Anatolia, 21, 31, 41, 91, 102–3, 117, 123, 150,
 - 158, 160
- antico rosso*, 91
- Apennine style ceramics, 184
- apprenticeship, 12–13, 68, 70, 102, 105–6, 108,
 - 112, 114, 119–20, 134, 143, 145, 185,
 - 192, 200
- approaches
 - biological, 11, 13
 - biomolecular, 9
 - diffusionist, 31
 - Neo-Darwinian evolutionary, 11
 - phenomenological, 10
 - positivism, 2
 - post-colonial, 3
 - post-processual, 3, 11
 - processual, 2
 - situated learning, 12
 - world systems, 156
 - world systems analysis, 3
 - world systems theory, 11
- appropriation, 13, 32, 44, 65, 128, 130–32,
 - 145, 203
- Apsalos, 42
- Apulia, 146, 182–83
- Aramaic texts, 73
- Arctic Circle, 20
- Argolid, 92, 122, 151
- aromatics, 133, 140
- arsenic, 49, 100
- artisans, 8, 15–16, 69–70, 73, 85, 87, 89–91,
 - 102, 108, 111, 114, 116–17, 119–20,
 - 126–27, 184, 186, 188–89, 191, 195–96,
 - 200–1, 205
- ashlar, 70, 75, 80–81, 86–89, 90n2,
 - 103, 106
- Asia, 23, 165
- Aspra Kellia (Kythnos), 50, 53
- Aspros Pyrgos (Siphnos), 53, 59
- Assiros Toumba, 145–46, 149
- Assyrian, 4, 158, 160–61, 164–65
- Aswan, 69, 75–81, 83, 186
- Attica, 49–50, 54, 62
- Australia, 19
- Austria, 172
- Avaris, 29
- Avessalos (Seriphos), 51, 58, 62
- Axios valley, 146
- Axios/Vardar, 40
- Ayia Irini, 103–4, 112
- Ayios Sostis (Siphnos), 50–53, 56, 61
- Balearics, 22
- Balkan(s), 31, 39, 41–43, 138, 160, 178
- Baltic, 19–20, 164, 166, 170

- basalt, 69, 75, 80, 83, 123
 Basilicata, 183
 basketry, 23
 Berbati, 150
 Bernstorf, 165, 170
 black burnished, 34, 36, 38, 43, 45
 Black Sea, 19, 157, 164
 black topped, 36, 43
 Boeotia, 135, 141
 bone, 183
 British Isles, 163, 178, 194
 Bronze Age, 5–7, 15, 20, 28–29, 68, 71–73,
 92, 114, 117, 125, 137, 148, 155, 157–61,
 163–65, 167, 169–70, 172, 176, 179–80,
 182–83, 185–86, 188–92
 Early, 7, 10, 16, 46–47, 51, 51n3, 55, 58–61,
 64–65, 67, 161–62, 167, 184–85, 189, 195
 Late, 10, 15–16, 85, 94, 96–99, 116, 118, 121,
 125, 137, 146, 151, 158, 162, 182, 184,
 186–87
 Middle, 7, 74, 106, 109, 114, 162, 170, 176,
 182, 184, 187, 189
 Bulgaria, 40, 164

 calcium, 96–97
 California, 19
 Campania, 23, 146
 Canaanite, 173
 Cape Gelidonya shipwreck, 159, 164
 Cape Tzoulis (Kythnos), 50, 53
 Cappadocia, 41
 caravans, 24, 154
 carbonised plant remains, 124
 Carpathians, 174
 ceramics, 16, 35, 48–49, 77, 114, 116, 117n1,
 121, 187
 Cerveteri, 191
chaîne opératoire, 10, 66, 106, 111–12, 119–20,
 123–24, 126–27, 131, 133
 Chalcidice, 134, 137
 chariot, 154, 158
 Chile, 19
 Chrysokamino (Crete), 51n1, 51–52, 55, 58,
 61–62, 64, 65n8
 Cilicia, 117–18
 Classical
 archaeology, 4
 ideas, 5
 times, 24
 clay tablets, 28
 cobalt, 96–101
 colonisation, 2, 10, 103–4, 113, 119, 130, 160,
 172, 178, 188, 198
 Greek and Phoenician, 3–4
 colonised, 8, 14n5
 colonising, 165

 community(ies) of practice, 70, 104–5, 113,
 120, 144, 148, 185–86, 188, 200–2
 connectivity, 193
 consumption, 23, 29, 31–32, 34–35, 38, 41,
 44, 103, 106, 109–10, 122–24, 131,
 155, 204
 conspicuous, 45
 of drink, 34, 36
 of food, 34–36, 44–45
 of ornaments, 76
 cooking, 7, 34–35, 35n3, 37, 44, 44n6, 112, 126
 cooking pots, 35, 37, 44, 81, 102, 110, 133, 200
 Coppa Nevigata, 183
 copper, 21, 46, 48–51, 51n3, 53, 55, 61n6,
 59–62, 95–100, 137, 157, 164–66, 185
 copper slag heap, 53
 Corinth, 190
 craftsmen, 33, 73, 81, 104, 109, 111, 114,
 119n2, 133, 135n3, 191, 200
 Crete, 7, 10, 26, 70, 73, 85, 89–91, 102–4,
 108–9, 111, 113–14, 147, 152, 178, 188,
 197, 200
 cultivating, 7
 Cyclades, 6–7, 23, 41, 50–51, 55–56, 59–60, 63,
 65–66, 102, 104, 107, 111
 Cycladic
 Early, 65
 Late, 106, 108, 110
 Middle, 106, 108, 110
 Cycladic islands, 41, 49–50, 53, 53n5, 58,
 65, 106
 Cyprus, 21, 25–26, 28, 48, 90n2, 117–19,
 123, 125, 131n1, 134, 136, 149–50,
 157, 164

 Dardanelles-Marmara, 40
 Denmark, 167, 170, 175
 Dhaskalio Kavos (Keros), 51n1, 55, 57, 61
 diffusion, 2, 7, 31, 70, 92, 116, 194, 203
 Dimini, 39
 Dispilio, 41–42
 dissemination, 25, 28, 31, 43, 45, 114, 135,
 196–97, 199
 distribution, 155
 Dodecanese, 102

 Early Iron Age, 28, 118, 121, 146, 170
 EBA. *See* Bronze Age: Early
 Egypt, 15–16, 23, 68–69, 73–74, 81, 85, 94,
 97–100, 136, 149–50, 157–58, 166, 173,
 175, 178, 182, 185, 187
 Egyptian(s), 4, 69, 76, 80–81, 83, 85, 88, 91,
 94–95, 97–98, 101, 107, 164, 186,
 191, 201
 Elateia, 99
 EM. *See* Minoan: Early

- emulation, 105, 107–8, 110, 114n2, 118, 130
 encrusted, 138–39
 Etruria, 22, 182, 190–91
 Euboea, 141
 Europe, 3, 6, 9, 20, 25, 39, 71, 99, 129, 158–60, 162, 164, 166–67, 172, 174–75, 178, 180, 183, 189, 192, 204
 exotic stones, 83
- faience, 14, 177, 187
 Faiyum, 69, 75, 80–81, 83
 farming, 3, 5, 20, 25, 29, 172
 First Cataract, 76
 Fitch Laboratory, 10, 15, 116n
 France, 22, 178, 182
 Franchthi Cave, 22
 Frattesina, 173–74, 183, 187
 fresco(es), 15, 89, 91, 102, 107–8, 112, 203
- Gebel el-Ahmar, 76, 78, 83
 Gebel el-Asr, 75, 81, 83
 German, 167
 Germany, 162, 165, 169–70
 Gibraltar, 25
 glass, 14, 16, 49, 94–99, 101, 164, 177, 183, 187, 203
 making, 94, 96, 99, 187, 192
 vessels, 95
 globalisation, 1, 17
Glycymeris sp., 39
 gold, 48, 137, 165n1, 165–66, 170, 177, 179–80
 Gournia (Crete), 86
 Greco-Roman, 190
 Greece, 16, 31, 33, 40, 94, 99, 123, 125, 187
 central, 132, 141, 147, 152
 mainland, 10, 89, 125–27
 northern, 16, 32–34, 36, 39–41, 43–44, 184, 187
 southern, 7, 34
 Greek(s), 3–4, 7, 10, 40, 83, 97, 100, 122, 132, 160, 190
 archaic, 90
 mainland, 137
 Greek-style pottery, 191
 grey-on-grey, 36, 38, 38n4, 43
 grinding stone(s), 69, 75, 77–78
 grog, 123–26
 Guadalquivir, 22
 gypsum, 83, 86–87, 91
- handmade, 16, 124–25, 136–37, 140–42, 144–46, 148, 150, 178, 199
 Handmade Burnished Ware, 16, 117n1, 121–27, 149, 188
- Hatnub, 83, *see also* Wadi Gerrawi
 Hattusa, 92
 Hazor, 29
 Helladic
 Early, 65
 Late, 90–91, 98, 132, 135, 137–38, 140, 146, 148–49
 Heraion (Samos), 61
 Himalayas, 21
 Hittite, 70, 73, 91, 116, 173, 175, 178
 HMBW. *See* Handmade Burnished Ware
 hybridisation, 119, 131, 148
- Iasos, 103–4, 113
 Iberia, 21–22, 24, 157, 163, 194
 Iberian, 22, 174
 identity, 7–8, 31, 34, 107, 111, 113–14, 119–23, 127, 141, 145, 165, 167, 169–70, 172, 196, 205
 Iliad, 4
 imitation(s), 105, 109, 111, 131, 148
 immigrant(s), 16, 126, 190–91, 195
 impasto pottery, 125, 148–49, 178
 Indo-European, 167
 ingots, 16, 98–100, 164
 innovation, 8, 26, 29, 31, 78, 95, 108, 110, 112, 149, 184, 192, 202
 invasion, 2, 118, 178
 Iraq, 94
 Ireland, 163, 175
 iron, 50, 51n3, 54, 59, 97, 110, 123, 133, 141, 202
 Iron Age, 19, 22, 28–29, 116–17, 121, 125
 Israel, 23
 Istria, 165
 Italo-Mycenaean pottery, 147
 Italy, 10, 21, 25, 29, 125, 127, 134, 146–47, 149, 157, 160, 164, 166, 170, 173–75, 177–78, 182–87, 191
 itinerant(s), 12, 40, 43, 72, 87, 89, 92, 108, 119n2, 189–92, 195
 ivory, 164, 183, 187
- Jutland, 162–63, 166, 166n1
- Karum trade, 160–61, 164–65
 Kasela (Siphnos), 51n2, 53, 55, 57, 61–63
 Kastanas, 146
 Kastri, 56, 103
 Kavos Promontory (Keros), 55
 Kephala (Kea), 51n1, 61–62, 64
 Kephala (Seriphos), 51n1, 51–53, 56, 58, 60–63
 Kephala Petras (Crete), 51n1, 51–52, 55, 58, 61
 Keros, 41
 kiln(s), 16, 107, 124, 133, 141–42, 144, 148, 183

- Knossos, 29, 87–89, 99, 103, 107, 111, 113–15, 188
- Konakia (Keros), 51n3
- Kythera, 7, 22, 85, 103, 110, 114
- Island Project, 22
- Kythnos, 65n8
- landscape learning*, 13
- lapis lacedaemonius*, 91
- Last Glacial Maximum, 24, 29
- Lavrion, 50, 60
- Lawagetas, 167, 180
- LBA. *See* Bronze Age: Late
- LC. *See* Cycladic: Late
- lead, 46, 50–51, 53, 60–62, 96–97
- lead isotope, 53, 60
- lead isotope analysis, 46, 50, 55, 166
- lead-silver, 49, 60
- learning, 11–12, 66, 68–69, 71, 84, 102, 105, 107, 111–14, 134, 143–44, 185, 199–201, 205
- learning networks, 115, 120
- Lefkes (Kythnos), 51n1, 51–52, 61
- lens*, 173
- Levant, 24, 28, 90n2, 116–19, 123, 125, 127, 136, 149–50, 164, 166, 188
- Levantine, 26–27, 30, 74, 91, 116, 118–19, 125, 127, 150, 188
- Late Bronze, 121
- Libya, 157
- Libyan, 21
- Limenaria, 41
- LM. *See* Minoan: Late
- LN. *See* Neolithic: Late
- Macedonia, 16, 32–35, 38n4, 37–43, 144, 146, 150, 178, 196
- central, 7, 16, 37, 39, 41, 136–37, 140, 144, 146–50, 198–99
- macro-level, 7, 11
- macro-scale(s), 3, 5, 10–12, 104, 115
- Maghreb, 22
- magnesium, 96–97
- Makriyalos, 37, 39
- Malia (Crete), 86
- Malkata, 94
- Malta, 26
- Mandalo, 41
- manganese, 96–99, 110, 141
- Mani, 91
- marble, 39, 41, 54, 91
- maritime technologies, 158–59
- marriage networks, 5, 7, 12
- Masaai, 169
- material practices, 8
- matt-painted, 137, 139
- MBA. *See* Bronze Age: Middle
- MC. *See* Cycladic: Middle
- means of travelling, 194
- Melos, 40, 104
- mercenaries, 129, 156, 158–60, 164–66, 173–74
- Mesopotamia, 100–1, 119, 157, 164
- meso-scale(s), 12, 105, 127
- metal vessels, 103
- metallurgical ceramic, 61–62, 64
- metallurgy, 187
- metalworking, 47–49, 57, 185, 190
- micro-level, 7, 22, 105
- micro-scale(s), 6, 10–13, 104, 116–17, 127
- Middle Kingdom, 81
- middlemen, 33, 40, 43, 166, 198
- migrant potters, 197
- migrants, 12, 116–19, 127, 159, 178, 188, 191, 194–95, 197–98, 200
- migration(s), 1–3, 5–6, 31, 116, 118–19, 130, 151, 155, 160–61, 177–78, 190, 194, 198
- Miletus, 103, 113
- mining, 47–50, 59–60, 65–66, 166, 185, 195
- Minoan, 4, 15, 69, 73, 85, 87–88, 90, 102–6, 108, 110–13, 115, 166n1, 188
- Early, 64–65, 108
- Late, 90–91, 106
- Middle, 64, 106, 109
- Minoan vessels, 204
- Minoanisation, 6, 10, 102–5, 109, 112–14, 188–89
- Minoanised, 91
- MM. *See* Minoan: Middle
- MN. *See* Neolithic: Middle
- mobile artisans, 197
- mobile/travelling potters, 146, 198
- mobility technologies, 154, 157
- Monkedonja, 165
- Morava, 40
- Mycenae, 15, 24, 91–92, 99, 122, 150
- Mycenae, 4, 6–7, 16, 85, 90–91, 99, 114, 121–22, 126, 128, 130–32, 140, 144, 146–47, 149, 152, 165n1, 165–67, 169, 173, 175, 177, 180, 183, 188
- Mycenae, 100
- Mycenae, 89, 100–1, 123, 182
- Mycenae, 69, 90, 116, 160, 174, 178, 180
- Mycenae, 189, 195
- Mycenae, 10, 16, 119, 122, 124, 126–27, 130, 133–38, 141, 143–44, 146–47, 149–52, 160, 173–74, 180, 187, 198–99
- Mycenae, 136, 144–45, 148–50
- Mycenae, 6, 10, 130
- Mycenae, 135

- Naxos, 41
 Neanderthals, 24
 Near East, 15–16, 23, 94–95, 97, 99, 101, 158, 160, 165
 Neolithic, 3, 5, 10, 14, 16, 26, 29, 31, 31n1, 33–35, 38–41, 44, 75, 109, 157, 184
 Early, 31n1, 34
 Final, 7, 33, 46, 51n1, 56, 61, 64
 Late, 16, 31n1, 31–41, 43–45, 184
 Middle, 16, 31n1, 31–38, 41, 44–45, 184
 Neopalatial, 86–88, 90, 103, 108–13, 115, 186
 network analysis, 155
 New Kingdom, 77–78, 166
 nickel, 97–99
 Niger, 198
 Nile, 21, 27, 69, 76, 80
nodes, 194
 Nordic, 161, 166–70, 172, 180
 Nuzi, 94, 191

 obsidian, 21–22, 40, 66, 182, 195
 Cappadocian, 41
 Carpathian, 41
 Melian, 22, 25, 40–41, 60
 Odysseus, 5, 156
Odyssey, 4, 30, 157
 Old Kingdom, 69, 73, 77, 80–83, 182, 186
 Olmo di Nogara (Verona), 176
 open-air mining, 50
 ornaments
 marine shell, 39, 41
 stone, 39–41

 palace(s), 10, 86, 88, 90, 118, 126, 132–34, 159, 165, 185, 189, 191
 Palaeolithic, 3
 Late, 77
 Lower, 77
 Upper, 25
 Palaikastro (Crete), 86–87
 Paliopyrgos-Aspra Spitia (Kythnos), 51n1, 53, 56, 61–63
 Paros, 41
 Peloponnese, 132–33, 135, 147, 150, 152
 perforated furnace(s), 16, 61–65
 perfume, 20
 Peristeria (Crete), 90
 Persian Gulf, 19
 Persian invasion, 191
 Petra (Kythnos), 50, 53
 Phoenicia, 157
 Phoenician(s), 3–4, 27, 30, 160, 165
 Phournoi (Seriphos), 52–53, 56, 58, 60–61
 Phylakopi, 103–4, 109
 Pieria, 137

 Pithekoussai, 29
 Plakalona (Seriphos), 51n3, 59
 plaster, 103, 105–6
 Pleistocene, 18, 22, 24
 Po valley, 149, 165, 182
 potassium, 96–97
 potter's wheel, 16, 133, 136, 148, 151, 183, 186
 potters, 7, 15, 35–38, 42–43, 45, 87, 117, 119–20, 122, 124–27, 134–35, 138, 144–47, 151–52, 184, 188, 191, 197–98, 202, 204
 potting, 7, 30, 111, 119–20, 122, 125–26, 132, 134, 136, 138, 143, 146, 152, 197–98, 202
 Pounta (Kythnos), 51n1, 51–52, 56, 61
 'processual' archaeology, *see* approaches:
 processual
 production, 29, 45, 103, 117, 120, 125–26, 135, 147, 155, 204
 agricultural, 197
 household-type non-specialised, 124
 lead/silver, 60
 of glass, 94–95, 183, 187
 of lime plaster, 107–8
 of metals, 46–48, 55–56, 58–60, 64, 66
 of ornaments, 39
 of pottery, 10, 32–34, 36–38, 41, 102, 109, 132–34, 136, 144–45, 147, 149–50, 192
 of purple dye, 183
 of stone tools, 40–41, 76
 of vessels, 39
 production sequence, 49, 67, 113, 120, 122, 127
 Pueblo, 177
 Pylos, 15, 90n3, 90–91

 quarry(ies), 69, 71, 73–78, 80–87, 186, 201
 quartz, 96, 123

 Raphina, 51n1, 52n4, 54–56, 61–62, 64
 recycling, 23, 48
 Red Sea, 19
 Rhodes, 147
 Roman, 4, 29, 160, 172, 180
 Romanisation, 17, 113n2
 rotative kinetic energy, 141

 sail, 26, 28, 154
 sailing, 7, 27–29, 162
 Samuraj, 169
 Sardinia, 22, 24, 146, 149, 173, 190
 Scandinavia, 157, 159, 161, 163, 166–67, 170, 172, 180, 194, 204
 Sea People(s), 118, 172, 175, 178, *see also*
 Phoenicians
 Seraglio, 103, 113
 Seriphos, 63, 65n8, 65–66
 ship-building, 27

- ships, 27, 29, 154, 157–58, 161–62, 173, 175, 194
- shipwrecks, 23
- Sicily, 24, 146–47, 160, 177
- Sideri (Kythnos), 51n1, 53, 56, 61–62
- silicon, 96–97
- silver, 46, 50, 137, 166
- Siphnos, 60
- Sitagroi, 39, 41
- Skali (Siphnos), 51n1, 51n2, 51n3, 53, 55, 57, 61–62
- Skouries (Kythnos), 52–54, 56, 58, 61, 63, 66
- slag heap, 53
- smelting, 16, 46–48, 50–51, 51n3, 53, 55–56, 58–60, 61n6, 61–66, 184–85, 195, 201–2
- smelting furnaces, 63, 199
- sodium, 96–97
- Spain, 23
- Sparta, 91
- specialisation, 20, 70–71, 162
- Spondylus gaederopus*, 39, 41
- standardisation, 37, 110, 133, 187
- state administration, 181
- state involvement, 152, 181
- Stavroupoli, 42
- stirrup jars, 10
- stone tools, 40–41, 69, 75, 77, 80, 83, 103
- chipped, 39–40
- ground, 39–40
- polished, 39–40
- stone vessels, 80, 85, 87, 90–91, 103
- stonemason(s), 15, 68–73, 75–76, 78, 81, 87, 89–90, 201
- stone-worker(s), 68–69, 75, 78, 85, 87, 201
- stone-working, 68–72, 74–75, 78–81, 83, 85, 90, 92, 95, 185, 189, 201–2
- storage, 23, 34–35, 35n3, 45, 137
- storage pots, 35, 37, 81, 133
- strontium isotope analysis, 100, 155, 169
- Switzerland, 172
- Syria, 94, 117, 121, 199, 254
- Syrian, 24, 73, 117, 121–24, 126
- tableware, 35–39, 44–45, 126, 133
- Tavoliere, 29, 41
- technological knowledge, 1, 8–9, 14, 65–66, 105, 132, 148
- technological landscapes*, 10
- technological practice(s), 7, 10, 12–13, 20, 65–66, 102–3, 104n1, 104–5, 114, 128, 130, 151
- technological traditions, 70, 127, 144
- technologies of mobility, 15–16, 18, 24, 156
- Tell Kazel, 117, 121–23, 125–27, 188–89, 199
- Terramare culture, 172
- textiles, 23, 103–4, 158, 180
- Thasos, 41
- Thebes, 99
- Thermaikos gulf, 137
- Thessaloniki Toumba, 138, 146
- Thessaly, 29, 33–34, 38–39, 41, 43, 45, 141
- timber, 87, 103, 106, 162
- tin, 21, 97, 157, 164–65, 179–80
- Tiryns, 92, 173
- tools, 77
- Toroni, 137
- trade, 2, 5–6, 8, 10, 15, 18, 20, 23, 28, 40, 73, 113, 123, 129–30, 134, 151, 154, 156, 158–59, 162–65, 168, 170, 174, 177, 179–80
- traders, 9, 15, 30, 154, 156, 159–60, 162, 165, 167, 169–70, 172, 180, 183, 190
- transmission, 8, 11n3, 11–13, 14n5, 19, 22, 24, 27, 29, 42, 65–66, 69, 75, 80, 92, 105–6, 108, 112, 114, 116, 120, 128, 130–32, 134, 180, 185, 201
- transport amphoras, 10
- travelling warrior(s), 159, 164–66, 171, 174, 204
- Trianda, 103, 106, 113
- tripod cooking pots, 110
- Tura, 73, 83
- Tuscany, 185
- Tyrrhenian, 19, 22, 29, 134, 147, 183
- Ugarit, 166, 175
- Uluburun shipwreck, 28, 98–99, 157, 159, 164, 173
- utility, 194, 203–6
- value system, 15, 180
- vectors*, 194
- vicia*, 173
- Vinča culture, 41
- violin bow fibula, 175, 178
- Vivara, 29, 183
- Wadi Gerrawi, 81, 83, *see also* Hatnub
- Wadi Hammamat, 73, 83
- wagons, 24, 154, 158
- wall painting(s), 89, 102–3, 105–8, 110, 112, 199
- Wanax, 167, 180
- warriors, 180
- weaving, 20, 30, 103, 106, 112
- wheel, 16, 103, 105, 118, 124–25, 133, 141, 145, 150, 199, 205
- wheel-fashioning, 102, 110–12, 119, 133n2
- wheelmade, 131n1, 133n2, 140, 144–45, 148–49

wheel-making, 119, 122, 125
Widan el-Faras, 69, 74, 80–83, 186
wine, 20, 139–40, 177
wool, 165

Yali, 60

Zakros (Crete), 86

zinc, 97–99